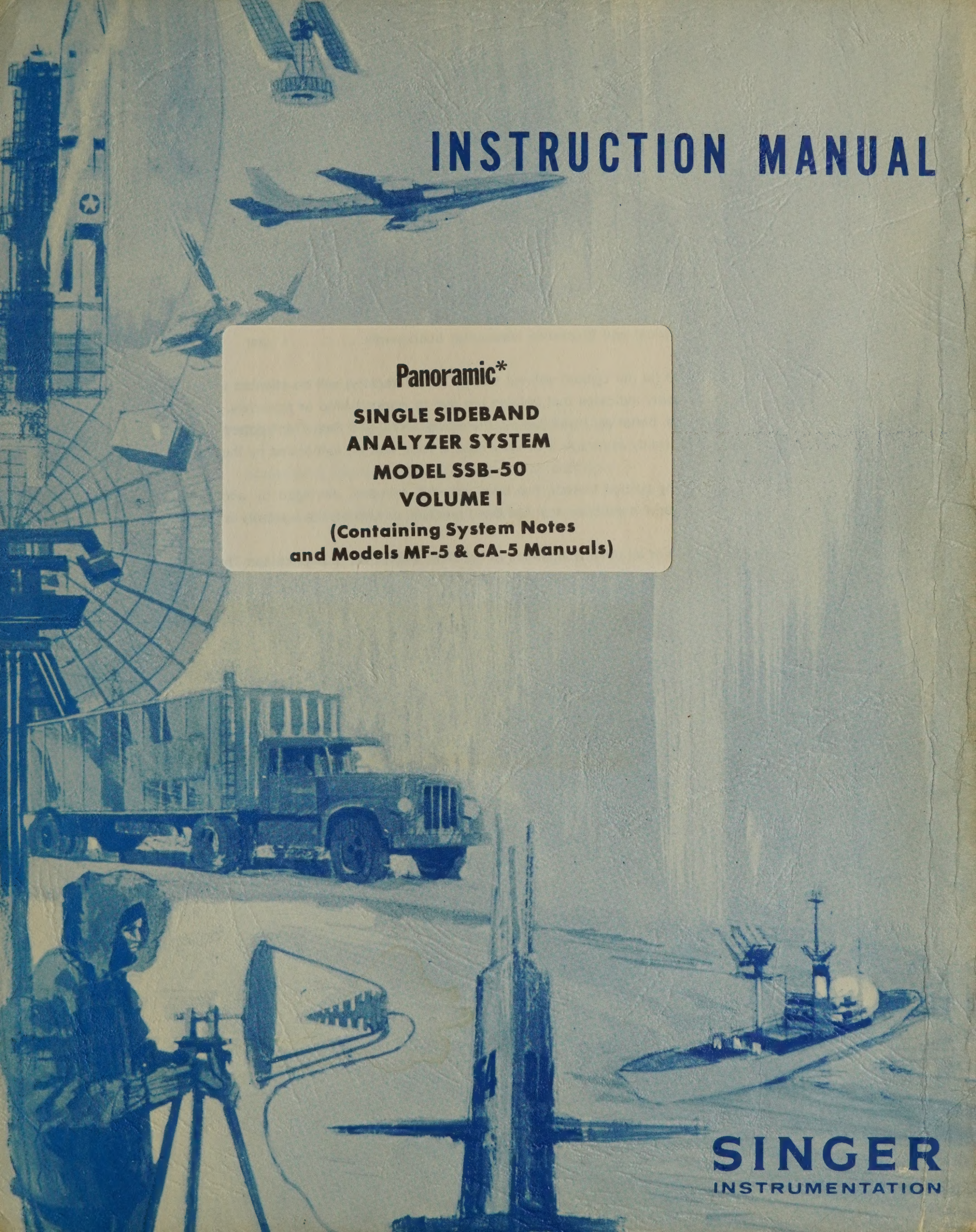

INSTRUCTION MANUAL

Panoramic*

SINGLE SIDEBAND
ANALYZER SYSTEM
MODEL SSB-50
VOLUME I

(Containing System Notes and Models MF-5 & CA-5 Manuals)

SINGER
INSTRUMENTATION

INSTRUCTION MANUAL

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SINGLE SIDEBAND
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SINGER
INSTRUMENTATION

Precision electrical and electronic instruments for measurement

emc — EMPIRE* — Gertsch* — Panoramic* — Sensitive Research*

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4. Test instruments used
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6. Approximate number of hours of use
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8. Other comments

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The Model SSB-50-A is identical to the standard Model SSB-50 with the exception of the Model REC-2 which has been removed.

INSTRUCTION MANUAL

Panoramic*

SINGLE SIDEBAND
ANALYZER SYSTEM
MODEL SSB-50

Serial No. _____

Instruction Manual No. 110-5041

SINGER
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Precision electrical and electronic instruments for measurement

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ADDENDUM

for

MODEL SSB-50 SYSTEM

I. PURPOSE.

To correct existing error in the handbook.

II. ADDENDUM.

Page 2-3, paragraph 2-19a should read:

"On the MF-5, adjust the VERT and HORIZ POS controls so that the CRT trace appears exactly under the bottom horizontal line engraved on the CRT graticule. If the trace extends beyond the calibrated screen limits, but not beyond the CRT screen area, no adjustment of the H SIZE control is necessary. If the trace does not reach the calibrated screen limits, adjust the H SIZE control as directed in paragraph 4-21 of the MF-5 manual. (Note: Adjustment of the H SIZE control affects interchangeability of the CA-5 with other PANORAMIC spectrum analyzer modules, and therefore is not recommended if other than a CA-5 is to be used with the MF-5.)

Addendum No. 517

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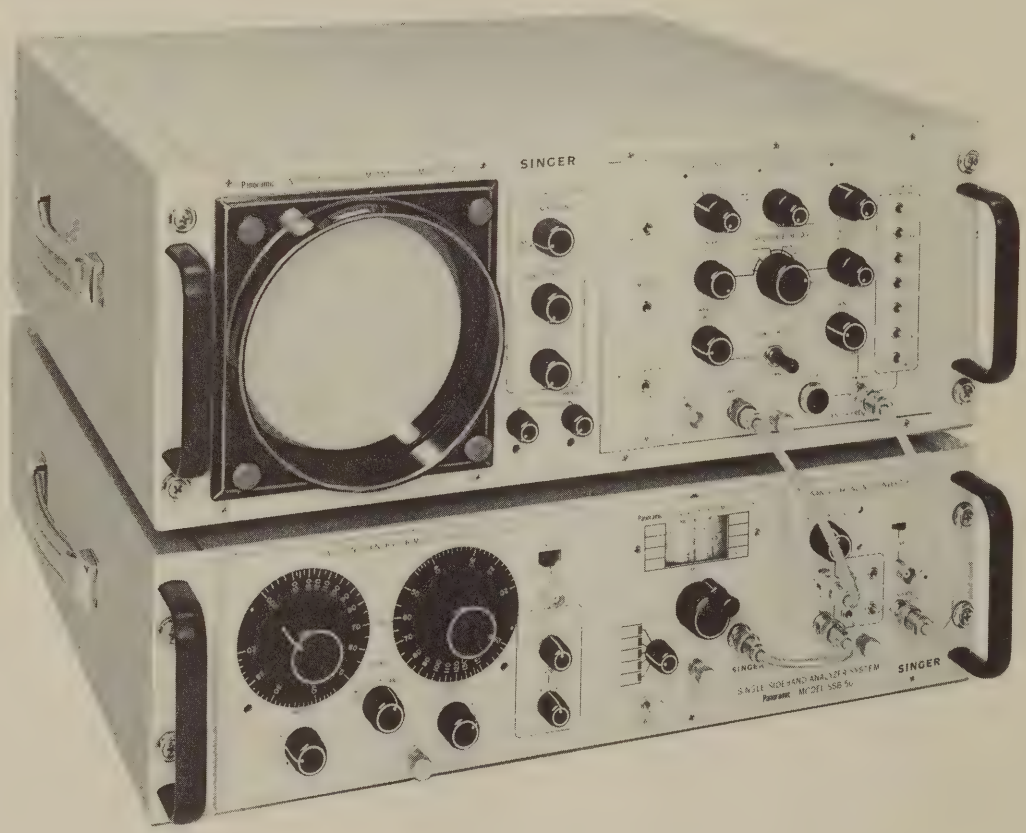

Figure 1-1. Model SSB-50 Single Sideband Analyzer System

SECTION I
INTRODUCTION

1-1. SCOPE OF MANUAL.

1-2. This instruction manual provides operating and maintenance instructions for the PANORAMIC* Single Sideband Analyzer System, Model SSB-50 (hereafter referred to as the SSB-50 System), manufactured by The Singer Company, Metrics Division. Included in the manual are: a general description of the SSB-50 System, supplied accessories, and available optional accessories; installation and operating instructions; and maintenance information and data. Similar coverage on the components of the SSB-50 System is provided in their respective instruction manuals. The SSB-50 System is illustrated in figure 1-1.

1-3. The information contained in this manual refers only to the standard version of the SSB-50 System and is current only to the date of publication. Difference in equipment components, specifications, and performance resulting from The Singer Company's continuous production improvement program or individual customer design and application requirements are described in addendum sheets.

1-4. PURPOSE AND USE OF EQUIPMENT.

1-5. The SSB-50 System is a compact, transistorized communications system test set designed to provide narrow-band spectrum analysis in the 10 Hz to 40 MHz frequency range. Operation to 160 MHz, at reduced sensitivity and dynamic range, is also possible. Typical applications include:

a. Rapid analysis of in-band distortion of SSB transmitters and exciters by the two-tone test method (to -60 dB).

b. Measurement of suppressed carrier levels, residual unwanted sidebands. Monitor transmission bandwidths.

c. Hum sideband studies (e.g., ± 60- or ± 50-Hz component readily analyzed down to -60 dB).

d. Out-of-band signal studies of harmonics, cross products, parasitics, etc.

e. Ideal for virtually any narrow band r-f studies of up to ± 50 kHz, as in a-m, f-m, p-m, and multiplexed channels.

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f. Single sideband receiver distortion and sensitivity measurements (with the addition of the Model TTG-5 Two-Tone R-f Generator to the SSB-50 System).

1-6. Inquiries are invited regarding special applications of the SSB-50 System to particular requirements. Such inquiries should be directed to the attention of the Applications Engineering Department.

1-7. GENERAL DESCRIPTION.

1-8. The SSB-50 System is a transistorized rack-mount test set consisting of two main frames (MF-5 and MF-50) and four plug-in modules (Panalyzor CA-5; Tuning head RF-8; Range Extending Converter REC-2; and Two-Tone Generator TTG-3). It provides high-stability spectrum analysis in the 10 Hz to 40 MHz frequency range, and a two-tone a-f signal for transmitter testing. Top quality, ruggedized printed circuit modules enable the SSB-50 System to provide trouble-free service under difficult field conditions as well as laboratory environments.

1-9. The SSB-50 System performance characteristics are equivalent to the highest quality vacuum tube SSB spectrum analyzers which are larger and heavier. Fully transistorized, the CA-5 Panalyzor occupies the module section of the Model MF-5 Main Frame. The Model RF-8 Tuning Head, REC-2 Range Extending Converter, and TTG-3 Two-Tone Generator plug into the Model MF-50 Main Frame. Specifications for frequency coverage, preset and variable (0-100 kHz) sweep width scan modes, 10-Hz selectivity with narrow skirts, distortion-free dynamic range for intermodulation measurements to greater than -60 dB, internal self-checking facilities, uniformity of response and others are in accordance with requirements for critical measurements of narrow-band SSB, multiplexed, and other modern communication signals.

1-10. The SSB-50 System is designed to be mounted in a standard 19-inch relay rack. It operates from either a 95- to 130-volt or 190- to 260-volt, 50- to 400-Hz, a-c power source.

1-11. EQUIPMENT SUPPLIED.

1-12. The equipment supplied consists of the Models MF-5 and MF-50 Main Frames, the Model CA-5

Panalyzor, the Model RF-8 Tuning Head, the Model REC-2 Range Extending Converter, the Model TTG-3 Two-Tone Audio Generator, interconnecting cabling, extender boards, a service cable, and an instruction manual. (See table 1-1.)

1-13. AVAILABLE OPTIONAL ACCESSORIES.

1-14. Optional accessories for use with the SSB-50 System are available. These accessories are described in paragraphs 1-15 through 1-20.

1-15. MODEL PRB-50 PROBE. The Model PRB-50 probe permits connection of signals from a high impedance source to the CA-5 Panalyzor or the REC-2 Range Extending Converter. The probe operates over the frequency range from 10 Hz to 40 MHz and has an input impedance of 10 megohms.

1-16. MODEL TTG-5 TWO-TONE R-F GENERATOR. The Model TTG-5 Two-Tone R-f Generator is a convenient source of two-tone excitation for SSB receiver distortion and sensitivity measurements, transmitter linearity checks, and linearity tests of other narrow band networks (e.g., filter and amplifiers).

1-17. MODEL GA-200 OR SM-200 POLAROID CAMERA. The Model GA-200 or SM-200 Polaroid Camera is used when permanent recording of the CRT presentation is required.

1-18. MODEL CMF-5 CARRYING CASE (Singer Part No. 102-0086-001). The carrying case permits transportation of the MF-5 unit (with the CA-5 installed) when a change of physical location may damage the equipment.

1-19. MODEL CMF-50 CARRYING CASE (Singer Part No. 102-0086-002). The purpose of this carrying case is identical to the CMF-5 carrying case.

1-20. MF-5 and MF-50 SLIDES. Slides are available for use with the main frames in the standard 19-inch relay rack.

1-21. EQUIPMENT SPECIFICATIONS.

1-22. Table 1-2 lists the technical and physical specifications of the SSB-50 System. Detailed specifications on the individual units of the SSB-50 System are given in the associated technical manuals.

TABLE 1-1. EQUIPMENT SUPPLIED

Nomenclature	Singer Part Number
Model MF-5 Main Frame	101-0004-001
Model MF-50 Main Frame	101-0371-001
Model CA-5 Panalyzor	101-0382-001
Model RF-8 Tuning Head	101-0143-001
Model REC-2 Range Extending Converter	101-0356-001
Model TTG-3 Two-Tone Audio Generator	101-0372-001
Interconnecting cabling (consisting of items 1 through 4)	
1. 5-Inch RF Cable	102-9200-203
2. 8-Inch RF Cable (2)	102-9200-200
3. AC Power Cable	102-9138-001
4. AC Line Cord	556161-066
CA-5 Extender Board (Board A2)	102-0097-001
CA-5 Extender Board (Boards A7 & A8)	102-0098-001
CA-5 Extender Board (Boards A1, A3-A6)	102-0099-001
MF-5 Extender Board	103-0399-001
TTG-3 Extender Board	102-0096-001
Service Cable (1)	556161-661
Instruction Manual	110-5041
No. 4 Allen Wrench	556005-125
No. 6 Allen Wrench	556005-123
No. 4 Spline Wrench	556005-012
No. 6 Spline Wrench	556005-011
Alignment Tool	556005-038
Line Cord Adapter	556010-230

TABLE 1-2. SPECIFICATIONS

Frequency range:	10Hz to 40MHz.
Sensitivity:	20-microvolt input produces at least a full-scale linear deflection on the CRT. Minimum measurable signal (at least one division) is approximately 2 microvolts.
Sweep width:	Preset: 150Hz, 500Hz, 3.5kHz, 7kHz, and 14kHz. Variable: 0 to 100kHz.
Sweep rate:	0.1Hz for 150- and 500-Hz preset sweep widths (may be increased to 1Hz with front panel control); 1Hz for 3.5-, 7-, and 14-kHz preset sweep widths; and 0.1 to 30Hz for variable sweep width; or manually controlled.
Resolution (3dB down):	10Hz to 3kHz adjustable. Automatic optimum resolution for the 5 preset ranges, with 50-Hz skirt selectivity at -60dB point for 150-Hz preset sweep width.
Dynamic range:	All in-band (odd order) intermodulation products at least 60 dB down.
Input impedance:	50 or 600 ohms, (switch selectable), 10Hz to 2MHz; 50 ohms, 2MHz to 40MHz; and 10 megohms, when optionally available PRB-50 Probe is used.
Two-Tone Audio Test Signals:	
Frequencies:	20Hz to 20kHz, continuously adjustable
Frequency accuracy:	±3 percent
Output level:	+10 dBm maximum into 600 ohms.
Output Attenuators:	0-70 dB in 1 dB steps, accuracy 0.05 dB/dB.
Distortion:	All harmonics and IM products less than -60dB below single tone between 100Hz and 10KHz. Less than -55dB from 20Hz to 20kHz.
Amplitude Uniformity:	±0.5dB
Hum and noise:	Better than -66dB below single tone level.
Self-test features:	
Two-tone test:	Two crystal-controlled r-f tones (3MHz and 3.002MHz).
Calibrating oscillator:	500-kHz crystal-controlled oscillator for checking center frequency.
Internal marker:	5-kHz oscillator modulates 500-kHz crystal-controlled oscillator to provide 5-kHz markers for sweep width calibrations to 100kHz.
Input power requirements:	95 to 130 volts or 190 to 260 volts (switch selectable), 50 to 400Hz single phase.
Power consumption:	50 watts maximum
Operating temperature range:	0 to +55°C (32 to 131°F)
Physical characteristics:	
Height:	12-7/32 inches
Width:	19 inches
Depth:	21-15/16 inches (Behind front panel)
Weight:	62 pounds

SECTION II

OPERATION

2-1. GENERAL.

2-2. This section contains installation and operating instructions for the SSB-50 System. The SSB-50 System has been factory tested and aligned and is shipped in a ready-to-operate condition. However, no attempt should be made to install or operate the equipment until the operator is thoroughly familiar with the contents of this section. Figure 2-1 is an outline dimension drawing of the SSB-50 System.

2-3. INSTALLATION.

2-4. To install the SSB-50 System in a standard 19-inch relay rack, place the Models MF-5 and MF-50 Main Frames (with plug-in modules installed) in the position desired and secure the front panel of each main frame to the vertical members of the rack with four screws. The MF-50 should be installed below the MF-5. Then determine whether the supply voltage is 110- or 220-volts ac and set the primary power select switch on each main frame to the appropriate position. On the MF-5, use a 3/4 (Delay) amp primary power fuse for 120-volt operation and a 3/8 (Delay) amp fuse for 220-volt operation. On the MF-50, use a 3/8-amp delay fuse for 120-volt operation and a 3/16-amp, delay fuse for 220-volt operation.

2-5. After the main frames have been installed in the rack, and power considerations have been accomplished, interconnect the system as shown in figure 2-2 and connect the a-c line cord from the MF-50 Main Frame to the power source.

2-6. INTERPRETATION OF TYPICAL SCREEN PRESENTATIONS.

2-7. Paragraphs 2-8 through 2-13 provide a description of the various types of signals displayed on the CRT of the SSB-50 System. Within a short period of time, the operator should be able to

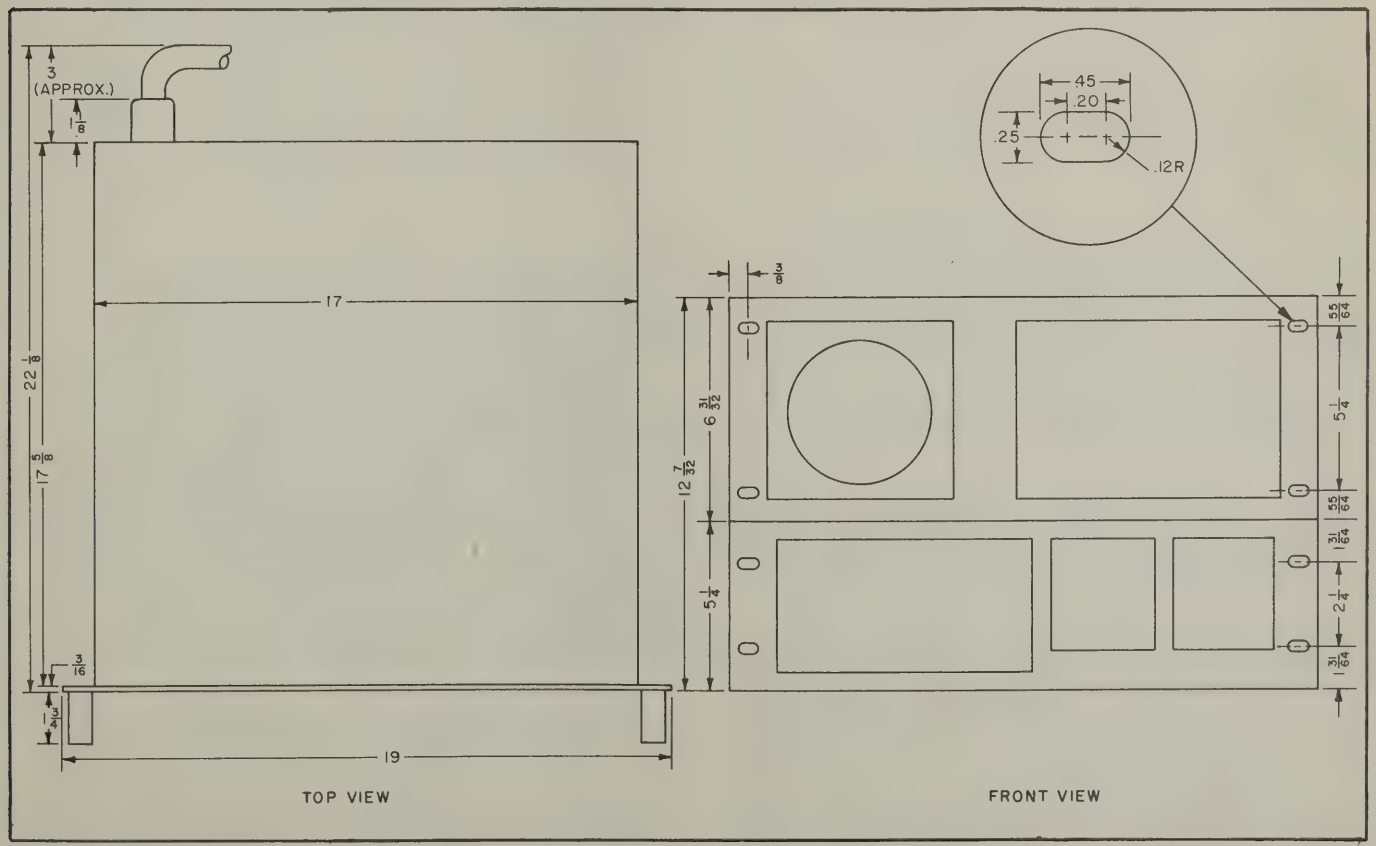


Figure 2-1. Outline Dimension Drawing, SSB-50 System

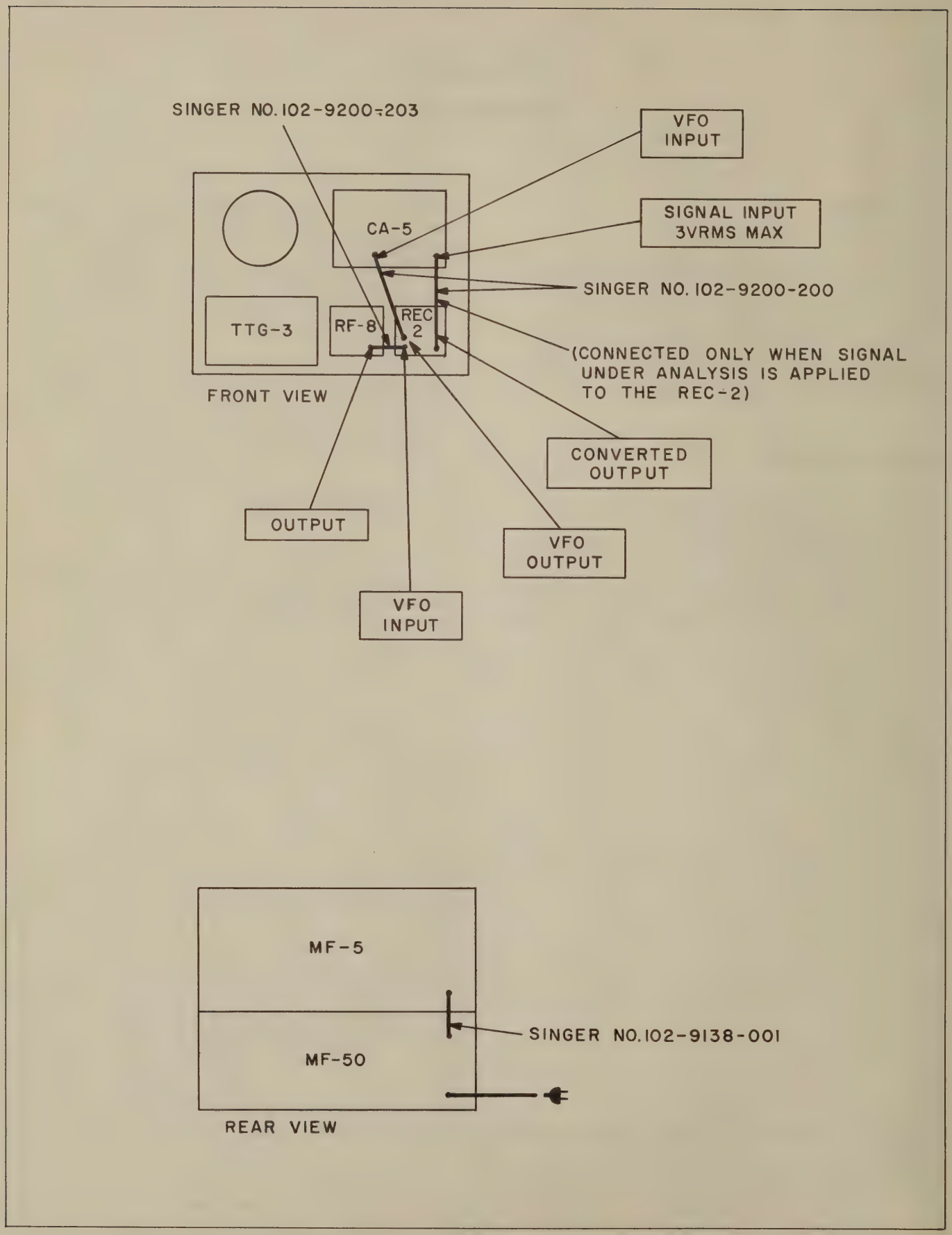


Figure 2-2. SSB-50 System, Interconnection Diagram

visually recognize the character of these various types of signals.

2-8. A constant carrier signal appears as a deflection of fixed height with the nature of presentation depending upon the sweep width. (See figures 2-3A and B.) Deviations of the signal from true cw will result in displays which will indicate the character of the signal as follows:

a. Oscillator drift - deflection moves slowly across the screen.

b. Periodic drift - deflection moves back and forth across the screen.

c. Squegging - interruption of an oscillator at a-f or i-f rate will result in a spectrum display resembling that of a pulse modulated signal. Sideband components will be present in addition to the oscillating frequency.

d. Keying - a cw signal appears and disappears in step with the keying of the signal source. During the moments when the signal is off, the frequency sweep axis is closed at the base of the signal. In very rapidly keyed signals the deflection and the baseline are seen simultaneously (on different sweeps). On narrow, highly resolved sweeps, keying sidebands may be visible as discrete signal components.

2-9. Two cw signals which are so close in frequency as to cause aural interference (beats) may appear on the screen as a single signal whose height varies with modulation. As the frequency separation is increased, the signal appears to be modulated on one side only. Further separation will cause a "break" in the apex of the deflection. By reducing the sweep width of the CA-5 Panalyzor, the two signals will gradually separate. Reducing the sweep width, reducing the sweep rate, and/or narrowing the i-f bandwidth may result in separation into two distinct pips. (See figure 2-3C.)

2-10. An amplitude-modulated carrier appears as a deflection of variable height, when the modulating frequency is very low. Non-constant tone modulation of low frequency will produce a series of convolutions varying in height along the side of the carrier pip. The nature of the presentation will depend upon the sweep width. As the modulation frequency increases, the convolutions move toward the two sides of the deflection, and the sidebands become visible. When the modulation frequency is increased, it becomes possible to separate the sidebands by reducing the sweep width of the CA-5 Panalyzor. The IF BANDWIDTH control will enable further separation. The higher the frequency of modulation, the farther away those sidebands will move from the center deflection, which represents the carrier. (See figure 2-3D.)

2-11. The appearance of single-sideband signals depends upon the type of modulation employed. Tone-modulated single-sideband signals appear as a carrier (for a single tone), or a series of carriers (for multi-tones) of slightly different frequency. Voice or music-modulated single-sideband signals appear as a "smear" of rapidly varying signals which occupy finite bandwidth. A typical screen presentation of an amplitude-modulated single-sideband signal without carrier suppression is shown in figure 2-3E.

2-12. Frequency-modulated carriers appear as a series of vertical deflections. (See figure 2-3F.) A carrier that is frequency-modulated at a low rate appears as a carrier which wobbles sideways. The vertical deflections shift rapidly when the carrier is modulated by voice or music. (See figure 2-3G.)

2-13. A pulse-modulated signal (figure 2-3H) will consist of a pattern of vertical spikes. The number of spikes is dependent on the pulse repetition rate, and the i-f bandwidth and the sweep rate of the CA-5 Panalyzor. The amplitude of each spike represents the amount of energy present at that particular frequency during one of the pulses. The peak envelope of all the spikes represents the energy-distribution pattern of the signal.

2-14. OPERATION.

2-15. OPERATING CONTROLS, INDICATORS, AND CONNECTORS. The operating controls, indicators, and connectors of the SSB-50 System are described in table 2-1 and shown in figure 2-4.

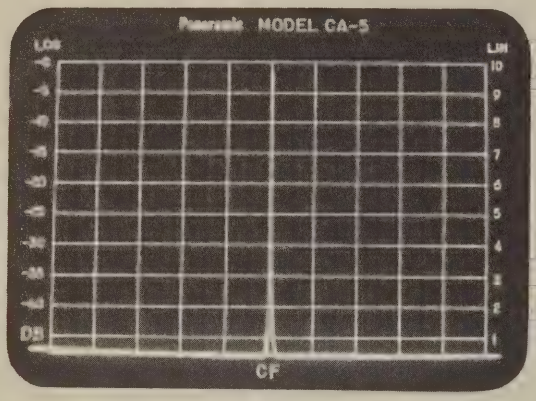
2-16. POWER APPLICATION AND PRELIMINARY ADJUSTMENTS. To prepare the SSB-50 System for operation, follow the procedures outlined in paragraphs 2-17 through 2-19.

2-17. Initial Control Settings. Set the controls of the SSB-50 System as indicated in table 2-2 before applying power to the equipment. Controls not specifically referenced in the table may be set to any arbitrary position.

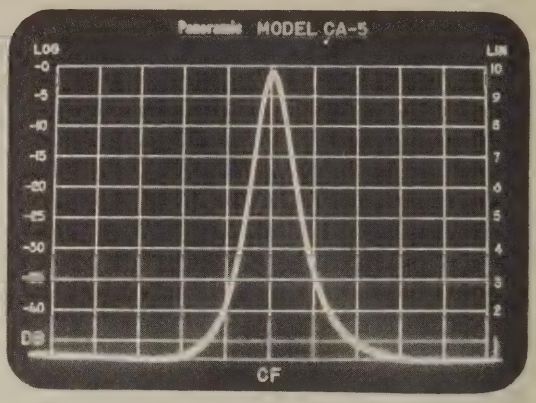
2-18. Power Application. With the SSB-50 interconnected as illustrated in figure 2-2, set the POWER switch on the MF-50 Main Frame to ON and the SCALE ILLUMINATION control on the MF-5 Main Frame clockwise until the CRT graticule illuminates. Then wait 30 seconds, and slowly turn the BRIGHTNESS control on the MF-5 clockwise until a trace is displayed on the CRT. Adjust the BRIGHTNESS and FOCUS controls on the MF-5 to obtain the desired trace.

2-19. Preliminary Adjustments. After the equipment has warmed up for at least 15 minutes, perform the preliminary adjustments described below.

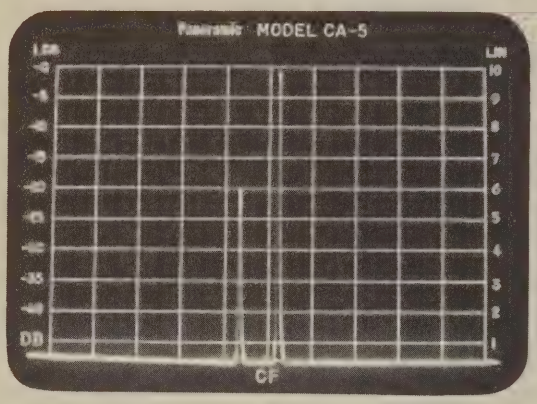
a. On the MF-5, adjust the VERT and HORIZ positioning controls so that the CRT trace appears exactly under the bottom horizontal line engraved on the CRT graticule. Then, if necessary, adjust the H SIZE screwdriver control to obtain a trace extending approximately 1/8-inch beyond each end of the engraved graticule markings. (Readjust the HORIZ positioning control, as required, when making the H SIZE adjustment.)



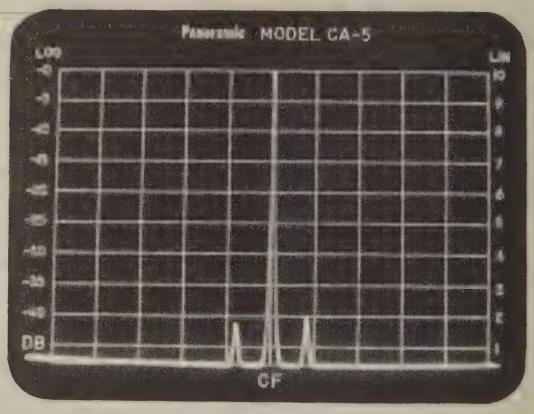
A. Constant carrier signal at approximately maximum sweep width



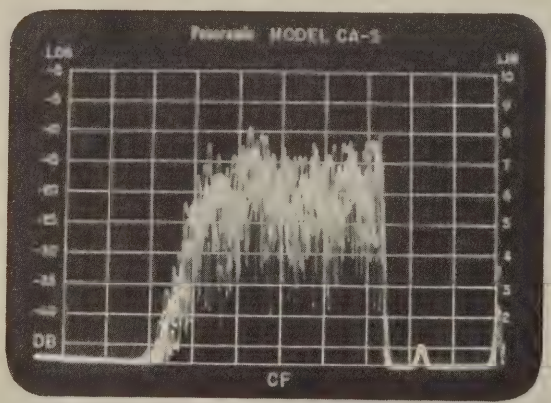
B. Same signal as "A" at reduced sweep width



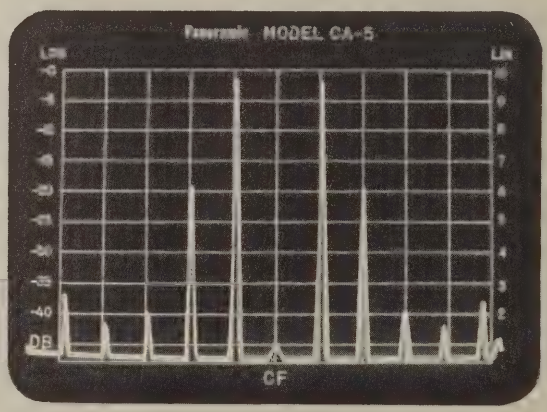
C. Two interfering carriers at optimum resolution



D. Amplitude-modulated signal showing carrier at the center and two sidebands

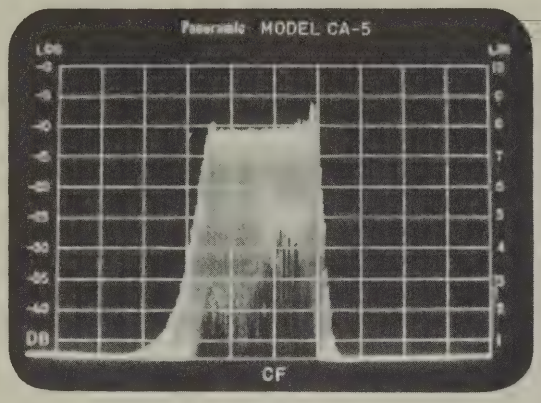


E. Single sideband signal without carrier suppression

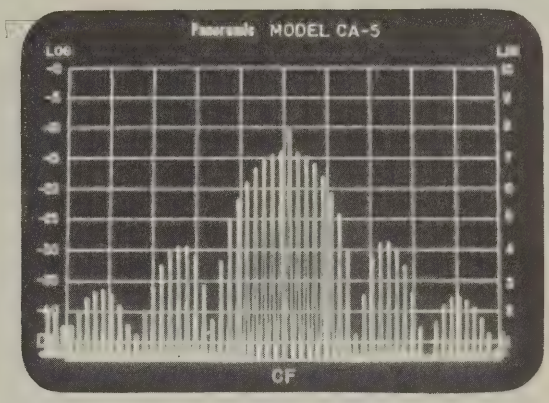


F. Frequency-modulated signal with carrier null

Figure 2-3. Typical CRT Presentations of Discrete Signals (Sheet 1 of 2)



G. Typical sideband energy of f-m signal, speech modulated. (Slow sweep and/or extended exposure photography are used to display envelope averages.)



H. Pulsed r-f signal

Figure 2-3. Typical CRT Presentations of Discrete Signals (Sheet 2 of 2)

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS

Index No. (Figure 2-4)	Name	Function
1	V and H SIZE screwdriver controls	Control the vertical and horizontal size of the CRT display.
2	CRT	Displays level versus frequency of signal input(s) to the SSB-50 System. CRT graticule contains a LOG amplitude scale calibrated from 0 to 40 DB, in 5 dB increments; and a LIN amplitude scale calibrated from 10 to 0, in 10 equal divisions.
3	VERT and HORIZ POS controls	Control the vertical and horizontal position of the CRT display.
4	FOCUS control	Controls sharpness and definition of display on CRT.
5	BRIGHTNESS control	Controls brightness of display on CRT.

(Cont'd)

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

Index No. (Figure 2-4)	Name	Function
6	SCALE ILLUMINATION control	Combination power switch and variable control. When turned clockwise from PWR OFF position (audible click can be heard), applies a-c power to the Model MF-5 Main Frame. Further clockwise rotation increases brilliance of CRT graticule illumination lights.
7	IF ATTENUATOR switch	Inserts either 20 dB or 0 dB of attenuation in the i-f amplifier of the CA-5. The switch must always be in the 0 dB position when making low level distortion measurements, thereby permitting the full 60 dB dynamic range of the CA-5 to be used.
8	VIDEO FILTER switch	Provides two degrees of video filtering (MIN and MAX) to suppress such unwanted effects as noise, spurious beating between closely spaced signals, hum, etc., on the signal(s) displayed on the CRT. Usable only in VAR position of FREQ SCALE Hz/DIV switch.
9	AMPLITUDE SCALE switch	Selects either LIN (linear) or LOG (logarithmic) voltage-amplitude scale of CRT display.
10	EXT CF MOD jack	Connects an external modulation (frequency markers) to the CA-5 for the CF position of the TEST SIGNAL-Hz switch.
11	TEST SIGNAL-Hz switch	Provides test signals to the CA-5 Panalyzor. In the CF position of the switch, a 500-kHz test signal is applied to the input of the CA-5 to locate the center frequency of the Panalyzor. In the 5K position, a 5-kHz signal (rich in harmonics) modulates the 500-kHz test signal to provide 5-kHz markers on the CRT for setting up sweep width. In the 3.0M & 3.002M position, a two-tone r-f test signal (3.0 and 3.002MHz) is mixed with the VFO input from the RF-8 tuning Head (3.5 MHz) to display a two-tone signal on the CRT. This position of the switch is used to check the odd-order distortion products of the CA-5.
12	CENTER FREQ LEVEL control	Adjusts the level of the 500-kHz test signal applied to the CA-5.
13	CENTER FREQ 1 control	Determines the center frequency of the CA-5 when the FREQ SCALE-Hz/DIV switch is either in the 15 or 50 position.
14	MANUAL SWEEP control	Permits manual control of the CRT sweep when the SWEEP MODE switch is set to MANUAL.
15	FREQ SCALE control	Adjusts the sweep width of the CA-5 from 0 to 100 kHz when the FREQ SCALE-Hz/DIV switch is set to VAR.

(Cont'd)

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

Index No. (Figure 2-4)	Name	Function
16	IF BANDWIDTH control	Adjusts the i-f bandwidth of the CA-5 when the FREQ SCALE-Hz/DIV switch is set to VAR. CCW rotation of the control narrows the i-f bandwidth and CW rotation broadens the i-f bandwidth.
17	FREQ SCALE-Hz/ DIV switch	Provides either five preset sweep widths (150 Hz, 500 Hz, 3.5 kHz, 7 kHz, and 14 kHz) or variable sweep width (VAR) in the CA-5. In the preset positions, the i-f bandwidth is automatically set for optimum resolution; and the sweep rate for the 150-Hz and 500-Hz preset sweep width is 0.1 Hz, while the sweep rate for the other preset positions is 1 Hz. In the VAR position of the switch, the i-f bandwidth, sweep width, and sweep rate are variable.
18	SWEEP MODE switch	Selects either the normal sweep rate for the five preset sweep width positions of the FREQ SCALE-Hz/DIV switch, a faster sweep rate (1 Hz) for the 150-Hz and 50-Hz preset sweep width positions of the FREQ SCALE-Hz/DIV switch, or a manual sweep for all the positions of this switch.
19	SWEEP RATE-Hz switch	Selects either a 0.1 to 1.5-Hz or 1.5 to 30-Hz sweep rate range in the CA-5 for the VAR position of the FREQ SCALE-Hz/DIV switch.
20	VARIABLE control	Operates in conjunction with the SWEEP RATE-Hz switch to vary the sweep rate on the CRT, when the FREQ SCALE-Hz/DIV switch is set to VAR.
21	CENTER FREQ 2 COARSE and FINE controls	Determines the center frequency of the CA-5 when the FREQ SCALE-Hz/DIV switch is set to either 350, 700, 1.4K or VAR.
22	GAIN control	Adjusts the amplitude of the indication on the CRT. Maximum gain is obtained with the control set to the maximum CW position. This control should be operated near maximum for measurements requiring the full 60 dB dynamic range of the CA-5.
23	ATTENUATOR switches	Provide attenuations of 1, 2, 4, 8, 15, 20, and 20 dB at the input of the CA-5. When the switches are in the IN position, the indicated attenuation is inserted.
24	VFO INPUT	Connects the VFO signal from either the REC-2 or RF-8 (obtained from the VFO OUTPUT jack on the REC-2) to the CA-5.
25	PROBE jack	Provides operating power to the optionally available PRB-50 Probe when in use.

(Cont'd)

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

Index No. (Figure 2-4)	Name	Function
26	SIGNAL INPUT-3 VRMS MAX jack	Connects signal(s) in the 2 to 40 MHz frequency range to the SSB-50 System. The signal(s) are either applied directly to this jack (when the MODE switch on the REC-2 is set to DIRECT) or indirectly via the REC-2 (when the MODE switch is set to CONVERTED 10 Hz-2MHz).
27	C and R BAL screwdriver controls	Suppress VFO leakage through the REC-2 at zero input frequency.
28	50 Ω -600 Ω switch	Sets input impedance of the SSB-50 System to 50 or 600 ohms when signal(s) under analysis are being applied to the SIGNAL INPUT 10 Hz - 2MHz jack on the REC-2 via the supplied coaxial cable. (When the optionally available PRB-50 Probe is used, the input impedance of the system is 10 megohms.)
29	SIGNAL INPUT 10 Hz - 2MHz jack	Connects signal(s) in the 10 Hz to 2 MHz frequency range to the SSB-50 System.
30	CONVERTED OUTPUT jack	Provides a 2.5-MHz converted output to the CA-5 when signal(s) in the 10 Hz to 2MHz frequency range are being applied to the SSB-50 System.
31	ATTEN DB switches	Provide attenuations of 5, 10, 20, and 20 dB at the input of the REC-2. When the switches are in the up position, the indicated attenuation is inserted.
32	VFO INPUT Jack	Connects the VFO signal from the RF-8 to the REC-2. This signal is either mixed with the 10Hz-2MHz input to the REC-2 to obtain the 2.5 converted output (MODE switch at CONVERTED 10 Hz2MHz) or applied to the CA-5 (MODE switch at DIRECT).
33	VFO OUTPUT jack	Connect either the VFO signal from the RF-8 or the REC-2 (whichever is selected by the MODE switch) to the CA-5.
34	MODE switch	Selects either the VFO signal from the REC-2 (3MHz) or RF-8 (2.5 to 40.5MHz) and energizes the REC-2 when analyzing signal(s) in the 10Hz to 2MHz frequency range. When in the DIRECT position of the switch, the VFO signal from the RF-8 is selected. When in the CONVERTED 10 Hz-2MHz position, the REC-2 is energized and its internal 3MHz signal replaces the RF-8 at the VFO output jack.
35	OUTPUT jack	Provides a VFO signal (2.5 to 40.5MHz) to the CA-5, via the REC-2.
36	Tuning Dial, MHz	Indicates the center frequency of the signal(s) displayed on the CA-5 CRT screen.

(Cont'd)

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

Index No. (Figure 2-4)	Name	Function
37	Tuning control	Permits the SSB-50 System to operate over the 10Hz to 40MHz frequency range by selecting the VFO signal that will be applied to REC-2 or CA-5. A FINE tuning rate is selected by pressing in the tuning control.
38	POWER INDICATOR lamp	Illuminates when a-c power is applied to the SSB-50 System.
39	POWER switch	When placed to the ON position, applies a-c power to the SSB-50 System.
40	RANGE selector switch	Selects the frequency range of the VFO signal from the RF-8.
41	600Ω TERMINATION switch	Inserts 600 -ohm termination (when set to IN) to maintain output level calibration accuracy when operating into high impedance loads.
42	ATTENUATOR DB units switch	Attenuates the two-tone a-f test signal up to 10 dB, in 1-dB steps.
43	ATTENUATOR DB decade switch	Attenuates the two-tone a-f test signal up to 60 dB, in 10-dB steps.
44	OUTPUT +10 dbm MAX jack	Connects the two-tone a-f test signal from the SSB-50 System to the unit under measurement(s).
45	LEVEL B screwdriver control	Adjusts output level of tone B of the two-tone a-f test signal at +10dBm into 600 ohms.
46	FREQ B multiplier switch	Decade range multiplier for tone B of two-tone a-f test signal.
47	FREQ B control and dial	In conjunction with FREQ B multiplier switch, determines frequency of tone B of two-tone a-f test signal.
48	OUTPUT selector switch	Selects either a single-tone or two-tone a-f test signal. In the SSB-50 System, the two-tone test signal is normally selected to check out SSB exciters and transmitters. If one tone is required (as for frequency response or harmonic distortion measurement), tone A should be used.
49	FREQ A multiplier switch	Decade range multiplier for tone A of two-tone a-f test signal.
50	FREQ A control and dial	In conjunction with FREQ A multiplier switch, determines frequency of tone A of two-tone a-f test signal.
51	LEVEL A screwdriver control	Adjusts output level of tone A of the two-tone a-f test signal at +10dBm into 600 ohms.

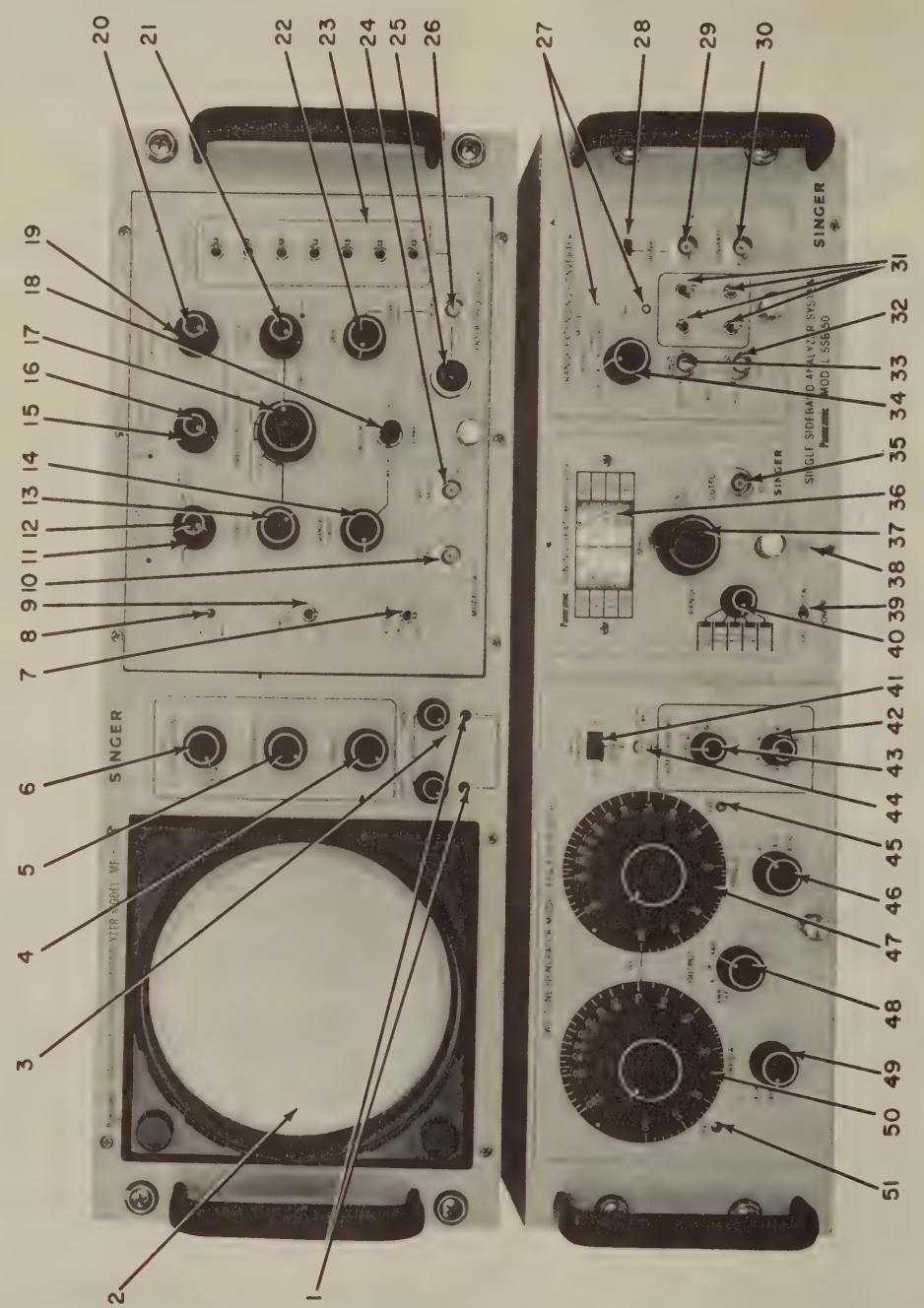


Figure 2-4. Operating Controls, Indicators, and Connectors

TABLE 2-2. INITIAL CONTROL SETTINGS

Control	Setting
MF-5	
SCALE ILLUMINATION control	PWR OFF (fully CCW)
BRIGHTNESS control	Fully CCW
CA-5	
FREQ SCALE-Hz/DIV switch	VAR
SWEEP RATE-Hz switch	1.5 - 30
VARIABLE control	Fully CW
ATTENUATOR switches	OUT position
GAIN control	Fully CW
IF ATTENUATOR switch	20 db
AMPLITUDE SCALE switch	LOG
TEST SIGNAL-Hz switch	OFF
SWEEP MODE switch	NORMAL
MF-50	
Power switch	OFF
TTG-3	
OUTPUT switch	PWR OFF
600Ω TERMINATION switch	IN
ATTENUATOR DB decade and ATTENUATOR DB ADD switches	0
FREQ A and B controls	100
FREQ A and B range multiplier switches	X10
REC-2	
MODE switch	CONVERTED 10Hz - 2MHz
50Ω -600 Ω switch	50 Ω
ATTEN DB switches	All in down position
RF-8	
RANGE switch	2.0 - 4.5
TUNING control	Rotated until a 0.0 tuning dial MHz indication is obtained on yellow band of 2.0 - 4.5 frequency scale.

b. On the REC-2, adjust the BAL C and R screwdriver controls to minimize the zero pip deflection on the CRT.

c. On the TTG-3, set the OUTPUT selector switch to A and connect a Hewlett-Packard Model 400D VTVM (or equivalent) to the OUTPUT +10 dBm MAX jack. Carefully adjust the LEVEL A screwdriver control until the VTVM indicates 2.45 volts. Then set the OUTPUT selector switch to B and carefully adjust the LEVEL B screwdriver control for the same indication on the VTVM. Disconnect the VTVM after the completion of this step.

2-20. SINGLE SIDEBAND ANALYSIS. The SSB-50 System checks out SSB exciters, transmitters, and receivers using the two-tone test method. During checkout of an SSB transmission system, a two-tone modulation signal is supplied to the exciter by the TTG-3 Two-Tone Generator. The signals present at various test points in the exciter and transmitter (see figure 2-5) are then analyzed by the CA-5 Panalyzor for intermodulation products, harmonic distortions, hum and noise, or other spurious signals. To check out an SSB receiver with the SSB-50 System, the optionally available Model TTG-5 Two-Tone R-f Generator is added to the system to provide an r-f two-tone input to the receiver. Similarly, the various test points in the receiver (figure 2-6) are then analyzed by the CA-5 to check distortion and sensitivity, gain, etc. The optionally available high impedance probe, Model PRB-50, may be used for measurements where low impedance (50 to 600 ohms) test points are not available. The following procedure outlines how to use the SSB-50 System for single sideband analysis. (For the procedure on how to monitor the various test points on the particular equipment on hand, refer to the equipment technical manual.)

a. Set the front panel controls as follows:

MF-5	
SCALE ILLUMINATION control	Rotated CW until CRT graticule illuminates
BRIGHTNESS & FOCUS controls	Adjusted for suitable trace on CRT
CA-5	
FREQ SCALE-Hz/DIV switch	VAR
SWEEP RATE-Hz switch	1.5-30
VARIABLE control	Fully CW
ATTENUATOR switches	IN position
GAIN control	Fully CW
IF ATTENUATOR switch	O db
AMPLITUDE SCALE switch	LOG
TEST SIGNAL-Hz switch	OFF
SWEEP MODE switch	NORMAL
MF-50	
POWER switch	ON
RF-8	
RANGE switch	As required
Tuning control	As required
REC-2	
MODE switch	As required

50Ω - 600Ω switch	As required
ATTEN DB switches	All in the up position
TTG-3	
OUTPUT switch	A & B
FREQ A control	70 — Typical frequencies. Any desired combination may be used
FREQ A multiplier	X10
FREQ B control	25
FREQ B multiplier	X100
600 Ω TERMINATION switch	As required
ATTENUATOR DB decade and ATTENUATOR DB ADD units controls	For suitable modulation level of the transmitter
TTG-5	
OUTPUT FREQUENCY-MC control	12.0 — Typical frequency. Any other desired frequency may be used.
TONE SPACING control	As required
OUTPUT SELECTOR switch	A + B
TONE A LEVEL and TONE B LEVEL controls	Each adjusted so that needle on OUTPUT meter coincides with red line labeled SET A OR B when OUTPUT SELECTOR switch is set to TONE A and then TONE B
OUTPUT LEVEL-DB BELOW 0.1 V (-7 DBM) switches	For suitable input to receiver

b. Before using the CA-5, set it to its 500-kHz center frequency as follows:

(1) Set the TEST SIGNAL-Hz switch to CF and adjust the CENTER FREQ LEVEL control until a full-scale signal pip is displayed on the CRT. (The GAIN control and ATTENUATOR switches may be used to reduce the CF signal level, if necessary.)

(2) Rotate the FREQ SCALE control in a CCW direction until the pip opens up into a horizontal line. Adjust the CENTER FREQ 2 COARSE and FINE controls, as required, for maximum height of the trace.

(3) Rotate the FREQ SCALE control to the fully CW position. Set the FREQ SCALE-Hz/DIV switch to the 1.4K position and adjust the CENTER FREQ 2 controls, if necessary, to position the signal pip under the CF line.

(4) Set the FREQ SCALE-Hz/DIV switch to 350. Readjust the CENTER FREQ 2 controls, if necessary, to position the signal pip under the CF line.

(5) Set the FREQ SCALE-Hz/DIV switch to the 350, 700, 1.4K and then VAR position and note that the signal pip is approximately at the same point on the horizontal scale for each of these switch positions. Adjust the HORIZ POS control on the MF-5, as necessary, to place the signal pip under the CF line. At the conclusion of this step, set the TEST SIGNAL-Hz control to OFF and the FREQ SCALE-Hz/DIV control to VAR.

c. Couple the signal to be monitored to either the SIGNAL INPUT jack on the CA-5 (when the RF-8 is providing the VFO input to the CA-5 and the MODE switch on the REC-2 is set to DIRECT) or the SIGNAL INPUT 10Hz-2MHz jack on the REC-2 (when the REC-2 is providing the VFO input and the MODE switch is set to CONVERTED 10 Hz-2MHz), using either the supplied coaxial cable or the optionally available PRB-50 Probe (when a high input impedance is required).

CAUTION

Do not apply a signal exceeding 3 volts (rms) to the equipment. If necessary, use suitable external attenuator pads to keep the input signal below this level.

d. Tune the RF-8 to the signal frequency and center the display on the CRT screen.

e. Set the FREQ SCALE-Hz/DIV switch on the CA-5 to either the 700 or 1.4K position. Center the display with the RF-8 tuning control.

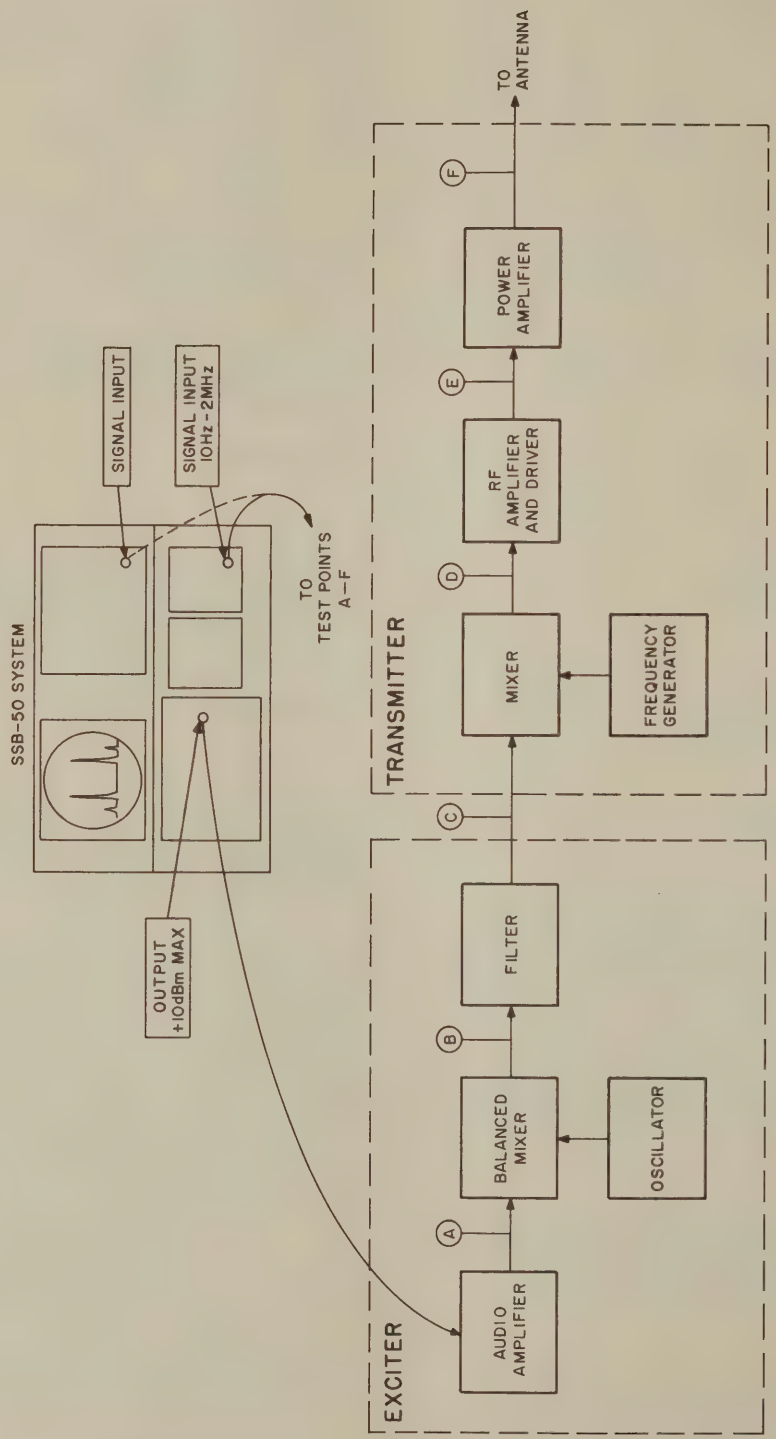


Figure 2-5. Testing of an SSB Transmission System with the SSB-50 System

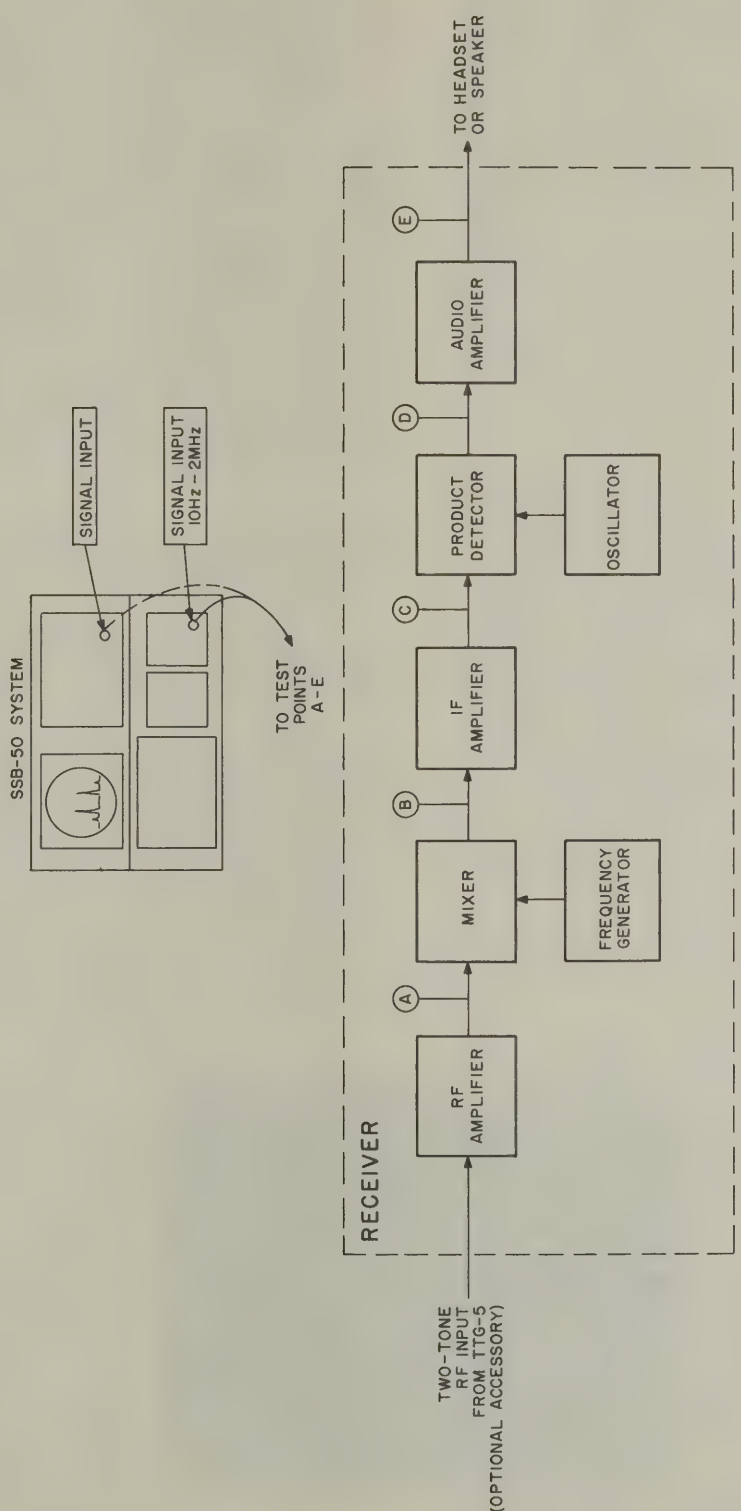


Figure 2-6. Testing of an SSB Receiver with the SSB-50 System

f. Set the IF ATTENUATOR switch on the CA-5 to 20 db. Set the ATTENUATOR switches on the CA-5 (and the ATTEN DB switches on the REC-2 if being used), as required, to bring the highest pip on the screen to just over full-scale deflection. Then, adjust the Panalyzor GAIN control to obtain exactly a full-scale deflection of the highest pip on the CRT graticule.

g. Major in-band intermodulation components may now be read in reference to the level of the two tones. The two-tone level is considered the 0 dB reference amplitude for comparison over a 40 dB range. The calibrations on the left side of the CRT graticule (0 to 40 DB, in 5-dB increments) are read directly in terms of dB down. To examine distortion products from 40dB to 60dB below the signal level, set the IF ATTENUATOR switch to 0 db. The upper dB portion of the display is now deflected off screen and the -20dB to -60dB portion is now displayed. Add 20 dB to the indicated reading to obtain the correct amplitude of the signals.

h. Odd-order distortion components are distributed symmetrically on either side of the main output signals and are located at separations equal to the frequency difference between them. The distortion components may be readily read as "dB down" from the reference levels. The third-order distortion components (first distortion pips) are usually the largest. Figure 2-7 illustrates a typical CRT presentation of a two-tone test. For a two-tone test, the CA-5 sweep width should encompass three to six times the difference between the two-tone input signals. If the sweep width is too narrow, it may not be possible to display both the primary r-f signals and their distortion products on a single sweep. When the sweep width is too wide, the two-tone pips merge and the distortion products cannot be resolved.

Note

In general, the two-tone pips should not intersect at a higher level than that of the distortion products (i.e., -60 dB for the full 60 dB range of the SSB-50 System). If the pips intersect, there may be an increase in the internal distortion of the CA 5 Panalyzor. Also, low level sidebands may not be adequately resolved under this condition.

2-21. NARROW BAND ANALYSIS. When signals or a carrier and its sidebands are so closely spaced in frequency that at full sweep width their corresponding deflections on the CRT tend to merge into each other or mask one another, it may be possible to separate or resolve the signals by either: sharpening the i-f bandwidth and reducing the sweep width; reducing the sweep rate; or by doing both of the foregoing. The following procedure applies for the VAR position of the FREQ SCALE-HZ/DIV switch on the CA-5.

a. To increase the resolution capabilities by sharpening the i-f bandwidth and reducing the sweep width, proceed as follows:

(1) Set the IF BANDWIDTH control maximum CW and center the band of signals of interest using the RF-8 tuning control.

(2) Spread the band of signals across the screen by turning the FREQ SCALE control in a CCW direction. Note that at reduced scanning width each frequency calibration mark represents a frequency separation equal to one-tenth of the reduced sweep width. Keep the band centered with the RF-8 tuning control. The CENTER FREQ 2 COARSE and FINE controls may be used for fine

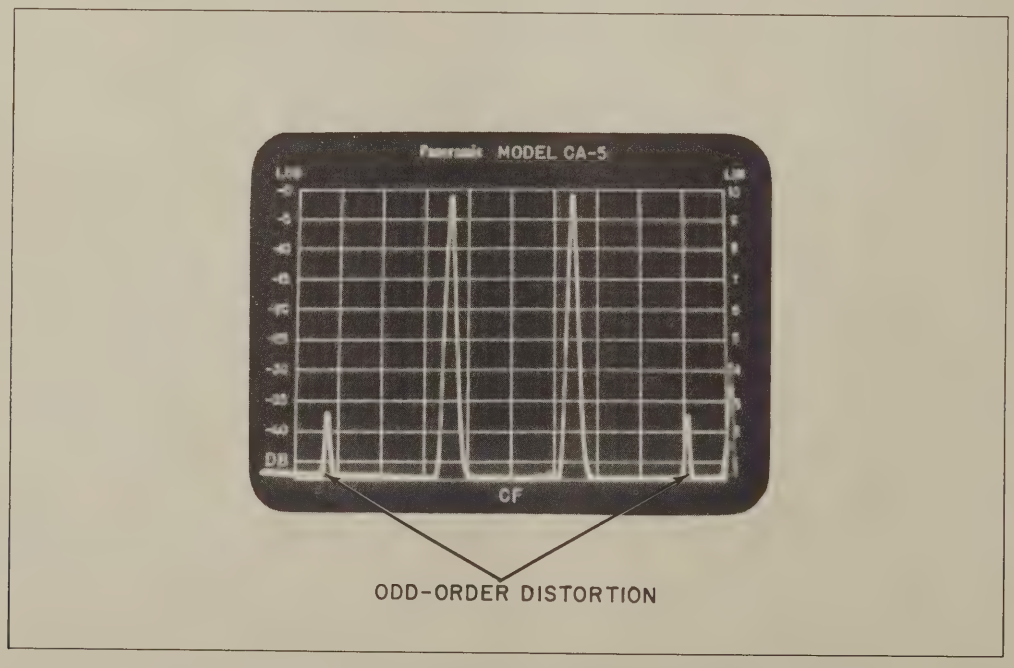


Figure 2-7. Typical CRT Presentation of Two-Tone Test

adjustments. However, avoid unnecessary changes of these control settings as this may result in loss of display when going to narrower sweep widths.

(3) Rotate the IF BANDWIDTH control in a CCW direction until individual signals are most clearly resolved.

Note

1. Rotation of the IF BANDWIDTH control may result in increased or decreased pip height. When this occurs, return the pip amplitude to a suitable level with the GAIN control.
2. Optimum resolution can be recognized by the presence of "ringing" on one side of the signal pip as illustrated in figure 2-8. ("Ringing" can be seen more easily with the VIDEO FILTER switch set to OFF.) Turning the IF BANDWIDTH control in a CCW direction, after optimum resolution is obtained, will decrease the resolving capability and result in greatly reduced sensitivity.

b. To obtain better resolution by reducing the sweep rate, set the SWEEP RATE switch to either 0.1-1.5 or 1.5-30 (switch position selected determined by desired degree of frequency separation and nature of signals). Rotate the VARIABLE CONTROL in a CCW direction until optimum resolution is obtained.

c. To obtain better resolution by sharpening the i-f bandwidth and reducing both the sweep width and sweep rate, proceed as follows:

(1) Repeat step a above.

(2) Turn the IF BANDWIDTH and FREQ SCALE controls in a CCW direction and set the SWEEP RATE-Hz switch to either the 0.1-1.5 or 1.5-30 position. Rotate the VARIABLE control in a CCW direction until optimum resolution is obtained.

Note

If it is necessary to observe a given bandwidth at one time and the signals involved are so closely spaced that they cannot be completely resolved, maximum resolution is recognized by the appearance of the clearest screen presentation. Further counterclockwise rotation of the IF BANDWIDTH control will result in lessened resolution and loss of signal amptitude.

2-22. LOCATION OF SIGNALS ON NARROW SWEEP WIDTHS. The following procedure is recommended for the acquisition of signals to be displayed on the CRT for the 15 and 50 positions of the FREQ SCALE-Hz/DIV switch.

a. Set the FREQ SCALE-Hz/DIV switch to 15.

b. Set the TEST SIGNAL-Hz switch to CF and adjust the CENTER FREQ LEVEL control to approximately its mid-position.

c. Set the SWEEP MODE switch to MANUAL. With the MANUAL control, position the CRT dot at the CF mark on the screen. Carefully adjust the CENTER FREQ 1 control until the dot deflects upward and returns to the baseline. Then slowly turn the CENTER FREQ 1 control in the opposite direction until the dot is at its maximum vertical deflection. Adjust CENTER FREQ LEVEL or GAIN controls for approximately full-scale deflection of the dot.

d. Hold the SWEEP MODE switch in the FAST position and trim the CENTER FREQ 1 control until the pip (which will be broadened and distorted) is about 2 divisions to the left of the CF line. (In the NORMAL position of the SWEEP MODE switch, the pip should appear near the CF screen calibration).

e. Set the FREQ SCALE-Hz/DIV switch to 50. The pip should appear near the CF screen calibration. Turn the TEST SIGNAL Hz switch to OFF.

f. If the CENTER FREQ 2 controls have been set correctly, according to the procedure outlined in step b of Paragraph 2-20, it should now be possible to tune the RF-8 to display a centered signal pip on the VAR position of the FREQ SCALE-Hz/DIV switch, and to successively reduce sweep width while retaining the signal on the CRT screen. When going to the 50 and 15 positions of the switch, it may be necessary to readjust the CENTER FREQ 1 control to maintain a signal display. Avoid excessive adjustment of this control to prevent loss of display when changing frequency scale.

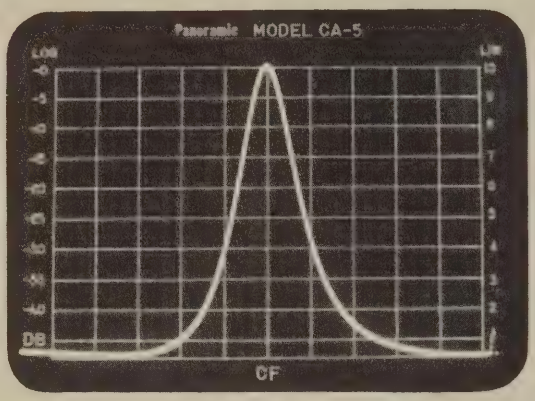
2-23. TURN OFF PROCEDURE. To turn off the SSB-50 System, set the POWER switch on the MF-50 Main Frame to the OFF position.

2-24. PACKAGING INSTRUCTIONS.

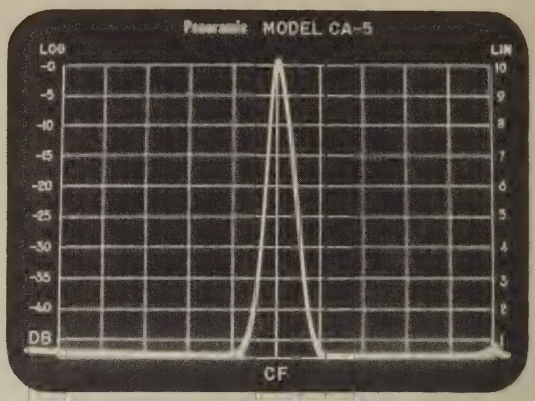
2-25. The following packaging instructions provide information for short-term and long term storage and shipping of the SSB-50 System.

2-26. SHORT-TERM PACKAGING. For short-term packaging, the SSB-50 System should be enclosed in a polyethylene bag and placed in a suitable carton for protection. The carton should be in a clean and moisture-free area. All accessories and literature should be securely fastened to the equipment.

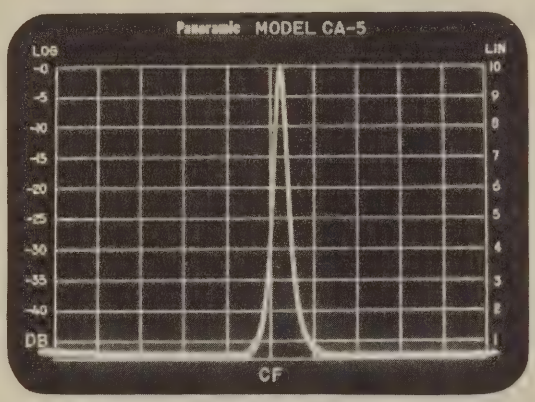
2-27. LONG-TERM PACKAGING AND PACKING FOR SHIPMENT. Figure 2-9 illustrates the packaging procedure for the SSB-50 System.



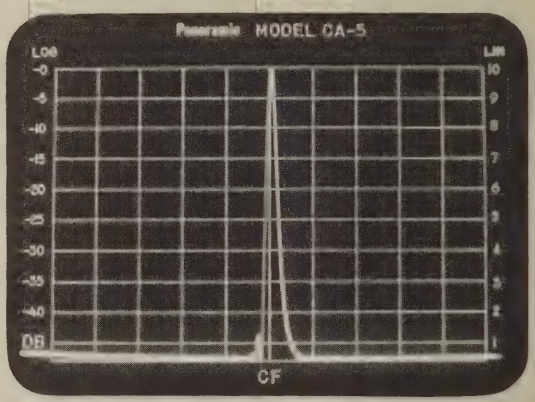
A. Narrow sweep width without resolution (no ringing)



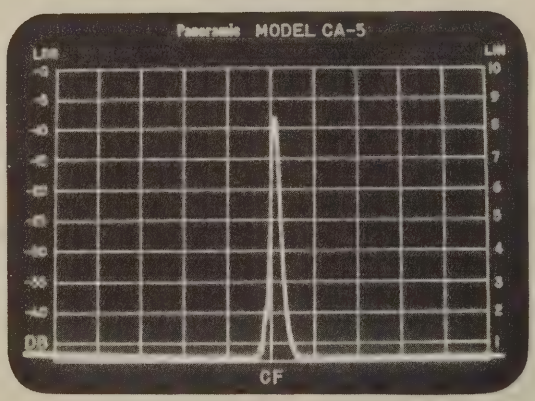
B. Wider sweep width without resolution (no ringing)



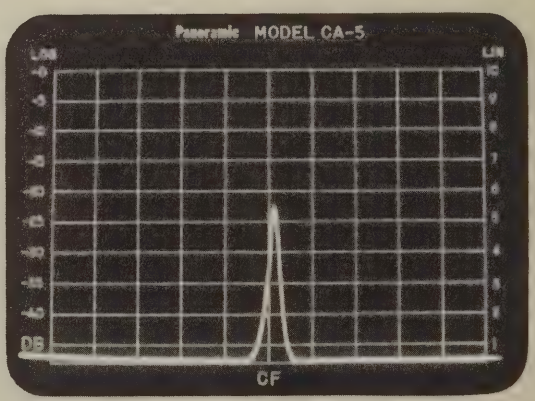
C. Under-resolved



D. Optimum resolution

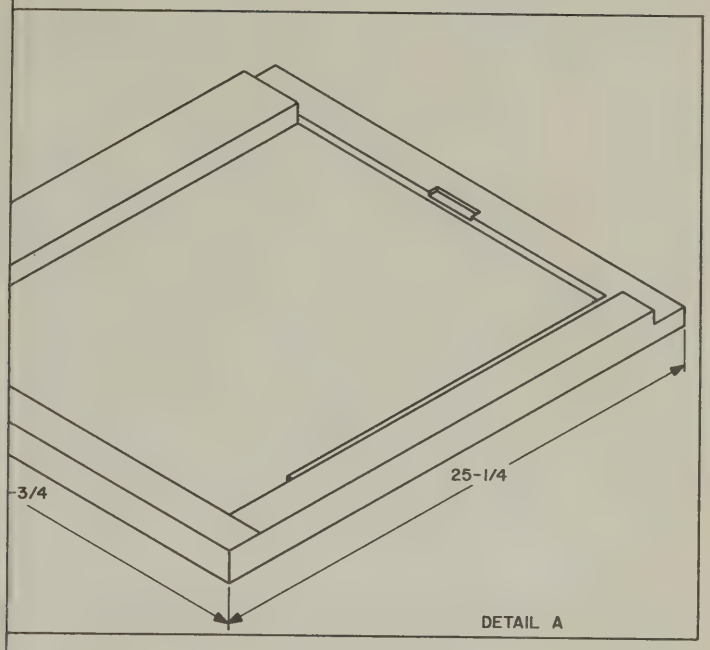


E. Over-resolved



F. Completely over-resolved

Figure 2-8. Ringing as an Indication of Optimum Resolution



BAG

ERIZED

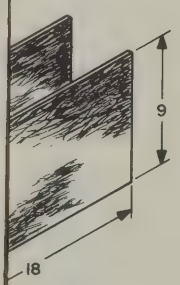
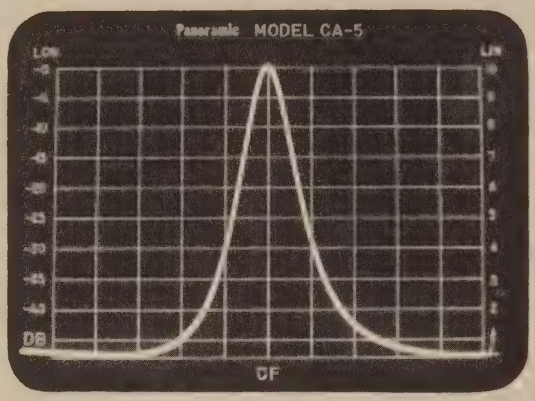
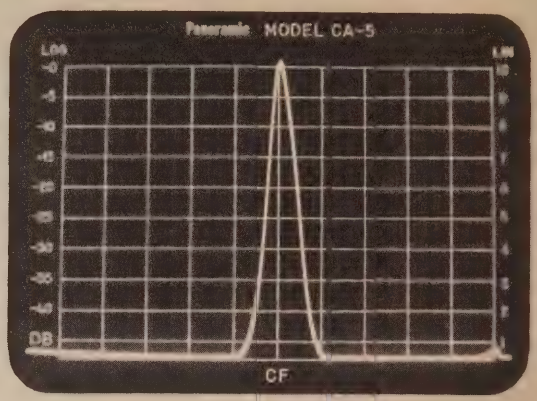


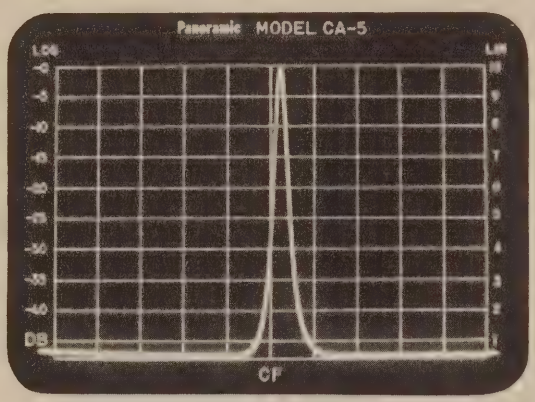
Figure 2-9. Packaging the SSB-50 System



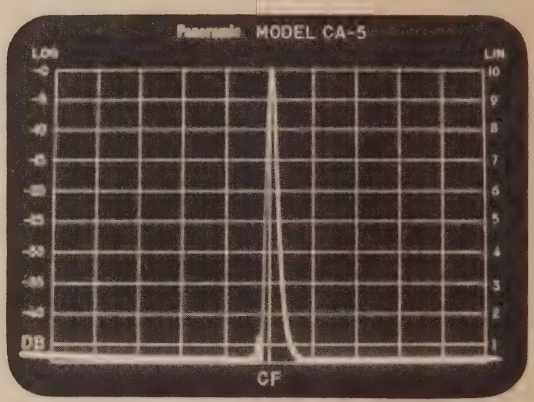
A. Narrow sweep width without resolution (no ringing)



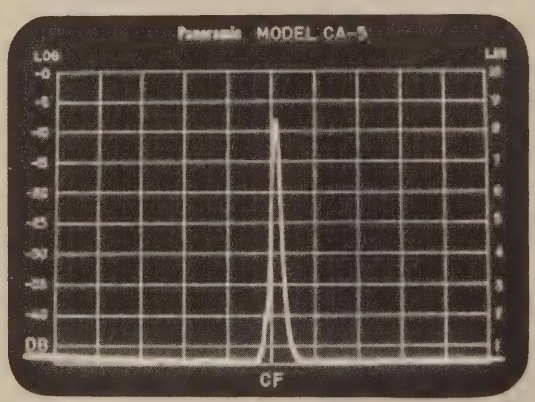
B. Wider sweep width without resolution (no ringing)



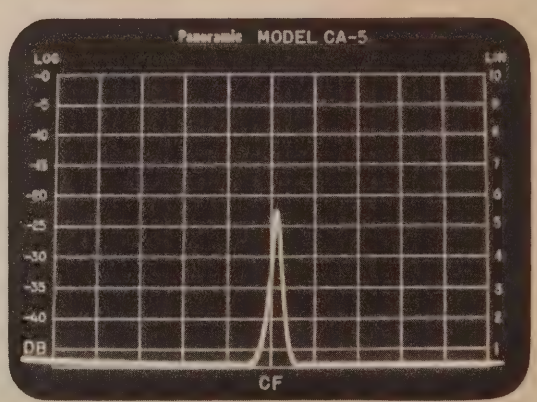
C. Under-resolved



D. Optimum resolution



E. Over-resolved



F. Completely over-resolved

Figure 2-8. Ringing as an Indication of Optimum Resolution

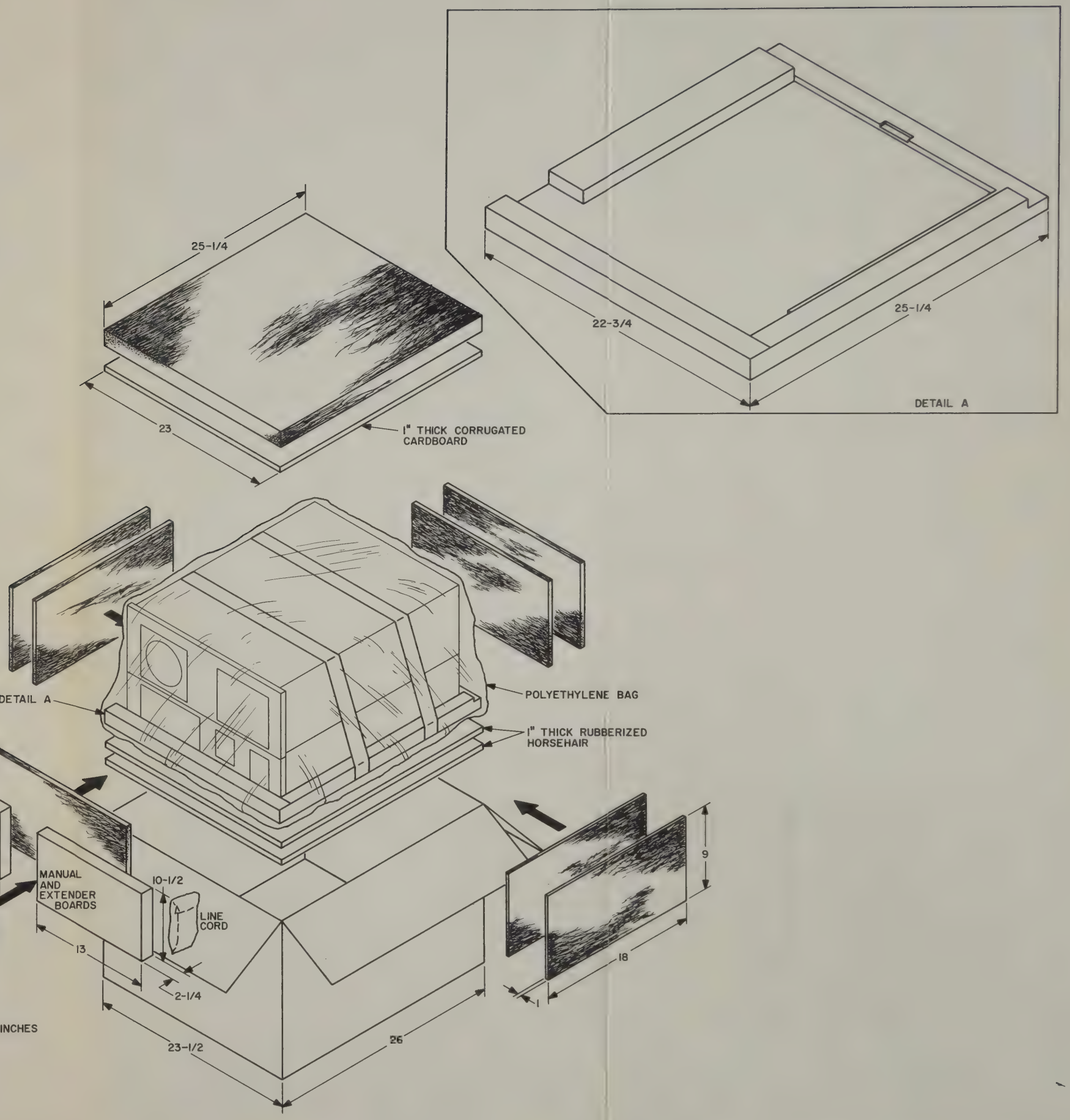


Figure 2-9. Packaging the SSB-50 System

SECTION III
SYSTEM CHECKOUT

3-1. GENERAL.

3-2. This section contains a checkout procedure for the SSB-50 System. This procedure provides a quick and reliable method for determining whether the SSB-50 System is operating properly. Also included in this section is a troubleshooting procedure to isolate a trouble in the SSB-50 System to a unit or units. Detailed checkout and troubleshooting procedures for the various units are contained in their respective technical manuals.

3-3. CHECKOUT PROCEDURE.

3-4. To checkout the SSB-50 System, interconnect the equipment as illustrated in figure 2-2 and perform steps a through i below.

a. Set the front panel controls of the SSB-50 System as follows:

MF-50	
SCALE ILLUMINATION control	Rotated CW until CRT graticule illuminates
BRIGHTNESS & FOCUS control	Adjusted for suitable trace on CRT
CA-5	
FREQ SCALE-Hz/DIV switch	1.4K
ATTENUATOR switches	OUT position
GAIN control	Fully CW
IF ATTENUATOR switch	20 db
AMPLITUDE SCALE switch	LOG
TEST SIGNAL-Hz control	OFF
SWEEP MODE switch	NORMAL
VIDEO FILTER switch	OFF
REC-2	
MODE switch	CONVERTED 10 Hz-2MHz
ATTEN DB switches	All in the down position
50 Ω - 600 Ω switch	600 Ω
RF-8	
RANGE switch	2.0 - 4.5
TTG-3	
ATTENUATOR DB decade and ATTENUATOR DB ADD units switches	0
600 Ω TERMINATION switch	IN

FREQ A and FREQ B controls	100
FREQ A and FREQ B multiplier switches	X10
OUTPUT control	A

b. Rotate the tuning control on the RF-8 until the zero pip appears under the CF line engraved on the CRT graticule. The amplitude of the zero pip should be half-scale LOG or less. If not, adjust the BAL C and R screwdriver controls on the REC-2 to minimize the zero pip deflection.

c. Connect a VTVM to the OUTPUT +10 dbm MAX jack on the TTG-3 and adjust the LEVEL A screwdriver control to obtain a VTVM indication of 2.45 volts.

d. Set the OUTPUT switch on the TTG-3 to B and adjust the LEVEL B screwdriver control until the VTVM indicates 2.45 volts. Disconnect the VTVM after performing this step.

e. Set the OUTPUT switch on the TTG-3 to A & B, the ATTENUATOR DB decade switch to 50, the ATTENUATOR DB units switch to 8, the FREQ B control to 30, and the FREQ B multiplier to X100.

f. Connect the +10 dbm MAX jack on the TTG-3 to the SIGNAL INPUT 10Hz - 2MHz jack on the REC-2.

g. Carefully adjust the tuning control on the RF-8 (and the CENTER FREQ 2 COARSE and FINE controls, as required on the CA-5) until the two-tones are centered on the CRT display; observe that a full-scale or better deflection is obtained on the CRT.

h. Adjust the GAIN control on CA-5, as required, until a full-scale deflection is obtained on the CRT.

i. Set the IF ATTENUATOR switch to 0 db and observe that all odd-order distortion products are below the -40DB line on the CRT graticule.

3-5. SYSTEM TROUBLESHOOTING.

3-6. System troubleshooting utilizes the checkout procedure outlined in paragraph 3-4 to isolate a trouble to a unit or units of the SSB-50 System. This procedure assumes that the interconnecting cabling is not defective. To troubleshoot the SSB-50 System, proceed as follows:

a. If the CRT graticule does not illuminate when performing step a of paragraph 3-4, the MF-5 or MF-50 is defective. To isolate the trouble further, observe whether the Power indicator lamp on the MF-50 is illuminated. If it is, the trouble is in the MF-5. If it isn't illuminated, the MF-50 is defective.

b. If a trace cannot be obtained on the CRT when performing step a of paragraph 3-4, the MF-5 or CA-5 is defective.

c. If no zero pip deflection is obtained on the CRT when performing step b of paragraph 3-4, the REC-2, RF-8 or MF-50 is defective. To isolate the trouble further, note whether the TTG-3 is operating properly. If it is, the trouble is in the REC-2 or RF-8. If the TTG-3 is not operating properly, the trouble is in the MF-50.

d. If the proper zero pip deflection cannot be obtained on the CRT when performing step b of paragraph 3-4, the REC-2 is defective.

e. If a 2.45-volt indication cannot be obtained on the VTVM when performing either step c or d of paragraph 3-4, the TTG-3 is defective.

f. If the two-tone test signal cannot be obtained on the CRT when performing step g of paragraph 3-4, the REC-2, RF-8, CA-5 or MF-5 is defective. To isolate the trouble further, set the TEST SIGNAL-Hz switch on the CA-5 to CF and the CENTER FREQ LEVEL control to its midposition. If a signal pip deflection is obtained on the CRT, the trouble is in the REC-2 or RF-8. If a signal pip deflection is not obtained on the CRT, the trouble is in the CA-5 or MF-5.

g. If the odd-order distortion products are not below the -40DB line on the CRT graticule when performing step i of paragraph 3-4, the TTG-3, REC-2, or CA-5 is defective.

INSTRUCTION MANUAL

Panoramic*

MAIN FRAME

MODEL MF-5

Serial No._____

Instruction Manual No. 110-5044

SINGER
INSTRUMENTATION

Precision electrical and electronic instruments for measurement

emc — EMPIRE* — Gertsch* — Panoramic* — Sensitive Research*

THE SINGER COMPANY • METRICS DIVISION

*A Trademark of THE SINGER COMPANY

ADDENDUM

for

MODEL MF-5 (SSB-50) MAIN FRAME

I. PURPOSE.

To correct existing errors in the handbook.

II. ADDENDUM.

a. In table 1-3, change F1 fuse type to read:

"3/4 amp delay (3/8 amp delay for 220 volt operation)"

b. Page 4-8, table 4-4 Sympton for step 8 should read:

"No pulses present at SYNC OUT connector J8 when companion madule employed has sync capability."

c. Page 4-9, paragraph 4-21, delete note after step b and add step c.

"c. Adjust the CA-5 controls as directed in paragraph 4-11 of CA-5 manual. Perform step 1a of table 4-3 in CA-5 manual. Adjust H SIZE and HORIZ POS controls to display sideband pips at extreme left and right screen calibration marks."

d. Page 4-9, paragraph 4-22 change to read:

"4-22. V SIZE R4. To perform V SIZE R4 adjustment, proceed as follows:

a. Perform the adjustments of paragraphs 2-8a through c of the CA-5 manual.

b. Connect the VOM between ground and the center conductor of Y OUT connector J7.

c. Adjust the V SIZE control R4 and VERT POS control R10 until the spot on the CRT screen coincides with the baseline at 0 volts and with the 0 dB screen calibration at 1.4 volts. Adjust the GAIN control of the CA-5 to adjust the voltage at J7."

2. Delete R1
3. Add the items noted below to the Parts List.

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
C2	CAPACITOR, FIXED, ELECTROLYTIC, 6500UF, PLUS 150, MINUS 10 PCT, 20V SINGER PART NO. 556160-029	539-2537-01	53021	1
C4	CAPACITOR, FIXED, ELECTROLYTIC, 1400UF, PLUS 150, MINUS 10 PCT, 20V SINGER PART NO. 556074-183	539-2546-01	53021	1
J3	CONNECTOR, PRINTED CIRCUIT, 15 CONTACTS SINGER PART NO. 168-3002-005	71-6015-1100 -00	95354	1
R5	RESISTOR, VARIABLE, 1 MEGOHM, PORM 20 PCT, 1/2W	556146-221	16665	1
R7	RESISTOR, VARIABLE, 5 MEGOHMS, PORM 20 PCT, 1/2W	556146-222	16665	1
A1R9	RESISTOR, FIXED, COMP., 100 OHMS, PORM 5 PCT, 2W SINGER PART NO. 151-1005-101J	HB1015	01121	1
A1R13	RESISTOR, VARIABLE, 1K OHM, PORM 30 PCT, 1/8W SINGER PART NO. 151-0021-003	U201R102B	71279	1
A1R25	RESISTOR, VARIABLE, 500K OHMS, PORM 30 PCT, 1/8W SINGER PART NO. 151-0021-012	U201R504B	71450	1
A2Q5	SANE AS A1Q5			

ADDENDUM

for

MAIN FRAME
MODEL MF-5 (SSB-50)

I. PURPOSE.

To correct existing errors in the handbook.

II. ADDENDUM.

a. On figure 5-1 (sheet 1) make the following changes:

1. Change voltage of C2 from "25 V" to "20 V"
2. Change A1C1 & C2 from "±5 PCT" to "±10 PCT, 50 V"
3. Change A1C3 & C4 from "±5 PCT" to "±10 PCT, 50 V"
4. Show A1Q5 and Q7 as being Factory Selected.
5. Show A2Q5 as being Factory Selected.
6. Change A3R1 through R4 from "±5 PCT" to "±10 PCT"

b. On figure 5-1 (sheet 2) make the following changes.

1. Change A2C1 from "0.47MF" to "0.47UF"
2. Change A2C2 from "0.1MF" to "0.10UF, 50V"

c. Make the following changes to the List of Replaceable Parts.

1. Add the following to table 6-1, Manufacturer Code:

Number	Name
95354	Methode Mfg., Co. Chicago, Ill.

ADDENDUM

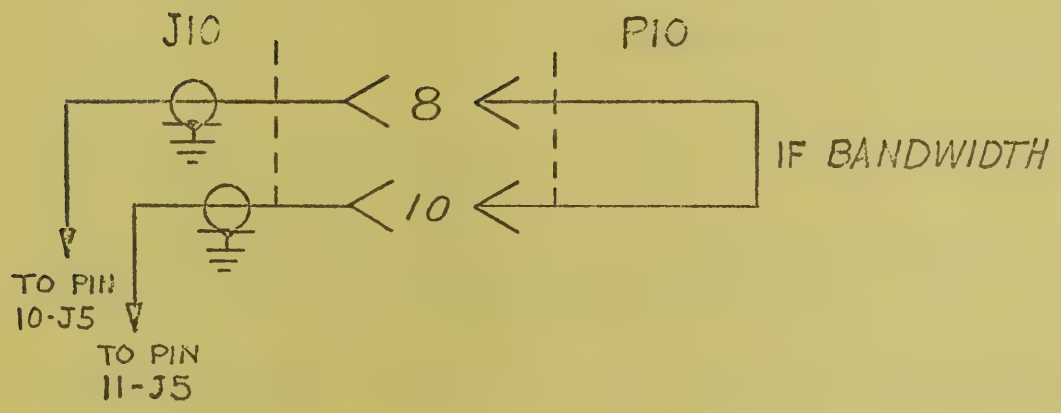
for

MODEL MF-5

(Effective on Serial No. U18048 thru U18121,
U18171 and Up)

Change Figure 5-1 as indicated below. This change does not effect operation of the SSB-50, SSB-50-1 or SSB-50/GD Systems. Wire connections to pin 8 of J10, pin 10 of J5, pin 10 of J10, pin 11 of J5, also pin 8 and 10 of P10 were made to make main frame capability with other plug-in modules used in this frame.

Add the following to Figure 5-1.



Addendum No. 545
(10 to 11)

ADDENDUM

for

MAIN FRAME MODEL MF-5
(USED AS PART OF THE SSB-50, SSB-50-1
and SSB-50/GD SPECTRUM ANALYZERS

I. PURPOSE.

To correct existing errors in this manual.

II. ADDENDUM.

The following changes must be made to correct this manual:

a. In table 1-3, fuse F1 rating should read, "3/4 ampere delay type for 110 volt operation or 3/8 ampere delay type for 220 volt operation".

b. In the Symptom column of table 4-4, step 8 should read, "No pulses present at SYNC OUT connector J8 when companion module employed has synchronization capability".

c. Insert the following in place of paragraph 4-22:

"4-22. V SIZE R4. To perform the V SIZE R4 adjustment, proceed as follows:

a. Perform the adjustments of paragraphs 2-8a through 2-8c of the Model CA-5 Panalyzor manual.

b. Connect the VOM between ground and the center conductor of Y OUT connector J7 on the Model MF-5 Main Frame.

c. Set the SWEEP MODE switch on the Model CA-5 Panalyzor to NORMAL position.

d. Set the TEST SIGNAL-Hz switch on the Model CA-5 Panalyzor to CF position.

e. Adjust the CENTER FREQ LEVEL on the Model CA-5 Panalyzor for a full scale marker pip on the Model MF-5 Main Frame CRT display with the AMPLITUDE SCALE switch on the Panalyzor in the LIN position.

f. Place the SWEEP MODE switch on the Model CA-5 Panalyzor in the MANUAL position.

g. Using the MANUAL SWEEP control on the Model CA-5 Panalyzor,

adjust the sweep so that a full-deflection spot appears on the Model MF-5 Main Frame CRT display (i.e., on the LIN 10 horizontal division of the CRT graticule). This spot should be centered on the CF horizontal division of the CRT graticule.

h. Alternately adjust the VERT POS and V SIZE controls on the Model MF-5 Main Frame until a shift of 1.4 volts dc on the VOM scale corresponds to a full-scale spot movement on the CRT display. The VERT POS and V SIZE controls interact and must be readjusted each time until the full-scale deflection is obtained.

NOTE

If adjusting the VERT POS and V SIZE controls on the Model MF-5 Main Frame does not obtain the required results, adjust the GAIN control on the Model CA-5 Panalyzor. If this does not correct the situation, there is a defect in either the Panalyzor or the Main Frame that requires maintenance attention.

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LIST OF ILLUSTRATIONS

LIST OF TABLES

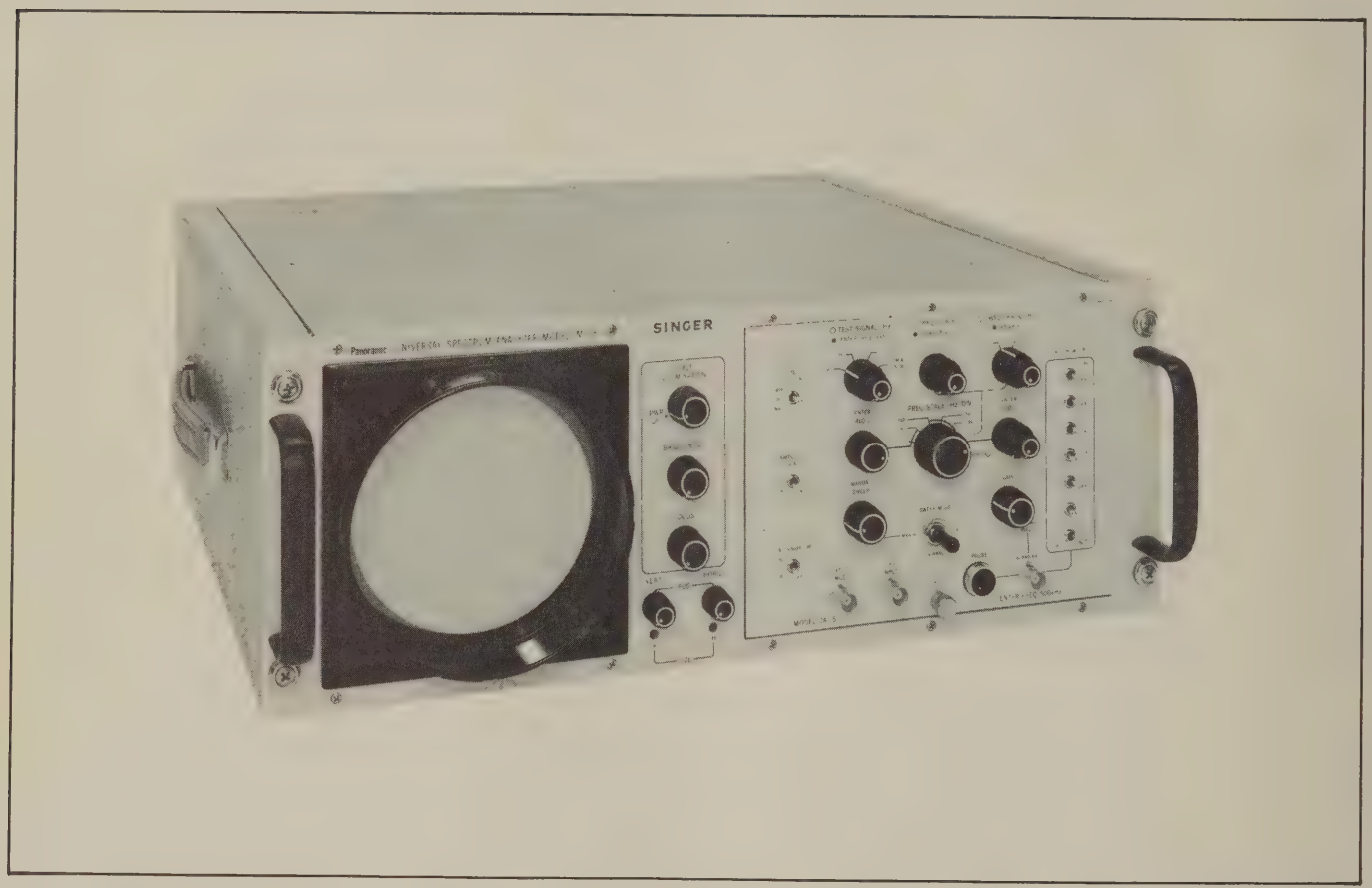

Figure 1-1. Model MF-5 Main Frame

SECTION I
INTRODUCTION

1-1. SCOPE OF MANUAL.

1-2. This instruction manual provides operating and maintenance instructions for the PANORAMIC* Main Frame, Model MF-5 (hereafter referred to as the Main Frame), manufactured by The Singer Company, Metrics Division. Included in this manual are a general description of the Main Frame, installation and operating instructions, theory of operation, maintenance information and data, schematic diagrams and repair parts list. The Main Frame is illustrated in figure 1-1.

1-3. Although the purpose of this manual is to provide coverage on only the Main Frame, the description assumes that the PANORAMIC Model CA-5 Panalyzor is mounted within the frame. Thus, reference to displays produced on the Main Frame CRT assumes a thorough practical knowledge of the CA-5 functions. Coverage similar to that presented herein on the Main Frame is provided in the CA-5 instruction manual.

1-4. The information contained in this manual refers to the standard version of the Main Frame and is current only to the date of publication. Differences in equipment components, specifications, and performance resulting from The Singer Company's continuous production improvement program or individual customer design and application requirements are described in addendum sheets.

1-5. PURPOSE AND USE OF EQUIPMENT.

1-6. The Main Frame is primarily designed to operate with the CA-5 Panalyzor in the PANORAMIC Model SSB-50 Single Sideband Analyzer System to display the level versus frequency plot for input signals to the CA-5. The displays appear on a long persistence CRT with a calibrated overlay graticule contained in the Main Frame. (See figure 1-2.) The Main Frame also provides the CA-5 with the necessary mounting enclosure and operating power. A description of the integrated operation and particular applications or the Main Frame are contained in the CA-5 instruction manual.

1-7. GENERAL DESCRIPTION.

1-8. The Main Frame contains deflection circuits, a CRT, and power supplies. In addition to providing voltages for the deflection circuits and CRT, the power supplies also furnish operating voltages for the CA-5. Since the majority of Main Frame circuits are transistorized, there is very little warm-up time required after turn-on. Solid-state design results in extraordinary display stability in addition to miniaturization.

1-9. The long-persistence CRT used for the Main Frame presentation provides a bright, sharply-focused display for convenient viewing. When permanent recording of the CRT presentation is required, the Polaroid Model SM-200 or GA-200 Oscilloscope Camera may be used. The 5-inch, round CRT used for the Main Frame display is equipped with a standard camera bezel, facilitating the use of the SM-200 and GA-200 cameras.

1-10. The Main Frame is designed to be mounted in a standard 19-inch rack. It operates from either a 95- to 130-volt or 190- to 260-volt, 50- to 400-Hz a-c source.

1-11. SPECIFICATIONS.

1-12. The electrical and physical characteristics of the Main Frame are listed in table 1-1.

1-13. ELECTRON TUBE, TRANSISTOR, CRYSTAL DIODE, AND FUSE COMPLEMENT.

1-14. Table 1-2 lists all tubes, transistors, and crystal diodes used in the Main Frame and table 1-3 lists the fuse complement.

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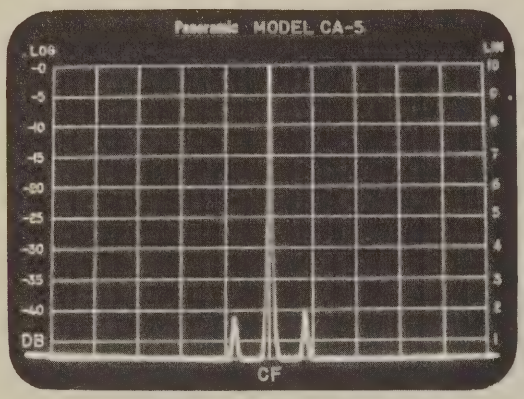
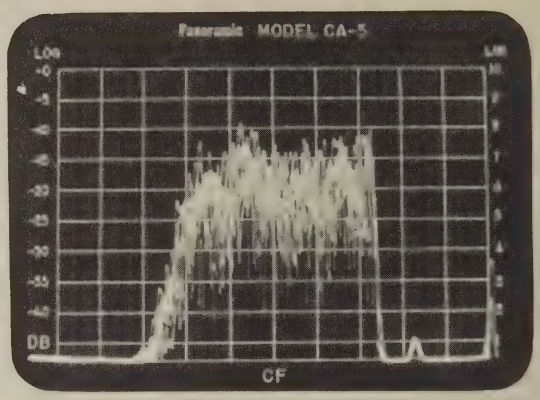


A. Amplitude-modulated signal showing carrier at the center and two sidebands.



B. Single-sideband signal without carrier suppression.

Figure 1-2. Typical CRT Displays

TABLE 1-1. SPECIFICATIONS

Input Power Requirements:	95 to 130 volts, 50 to 400 Hz, single phase, or 190 to 260 volts, 50 to 400 Hz, single phase
Sweep Rate:	Determined by associated plug-in module
Power Consumption:	30 watts maximum
Operating Temperature Range:	0 to +55°C (32 to 131°F)
Physical Characteristics:	
Height:	6-31/32 inches
Width:	19 inches
Depth:	21-15/16 (Behind front panel)
Weight (with plug-in module):	35 pounds, approximately
Cathode Ray Tube:	5-inch round

TABLE 1-2. ELECTRON TUBE, TRANSISTOR, AND CRYSTAL DIODE COMPLEMENT

Reference Designation	Type	Function
	Electron Tube	
V1	5ADP7	Cathode Ray Tube
A2V1	12AU7A	Vertical Deflection Amplifier
A2V2	12AX7A	Horizontal Deflection Amplifier
	Transistor	
Q1, Q2	2N2152A	Push Pull Amplifier
Q3	2N2152A	Series Regulator
Q4, Q5	2N1971	Series Regulator
A1Q1, A1Q2	2N2270	Multivibrator
A1Q3, A1Q4	2N2270	Differential Amplifier
A1Q5, A1Q7	2N404	Emitter Follower
A1Q9, A1Q10	2N2270	Differential Amplifier
A2Q1	2N696	Differential Amplifier
A2Q2	2N696	
A2Q3	2N3565	Compound Connected Y-Buffer Amplifier
A2Q4	2N3638	
A2Q5	2N404	Sync Output Amplifier
A2Q6	2N3638	X-Buffer Amplifier
	Diode	
CR1, CR2	10AG8 (Electronic Devices)	Rectifier
CR3, CR4	MR332R (Motorola)	Rectifier
CR5 thru CR8	1N4002	Rectifier
A1CR1, A1CR2	1N128	Steering
A1CR3, A1CR5	1N823A	Voltage Regulator
A1CR4	1N969B	Voltage Regulator
A2CR1	1N251	Limiter
A3CR1 thru A3CR4	EH300 (Electronic Devices)	Rectifier

TABLE 1-3. FUSE COMPLEMENT

Reference Designation	Type	Function
F1	3 amp (1.5 amp for 220 volt ac operation)	AC Primary Power
F2	3 amp	DC Primary

SECTION II

OPERATION

2-1. GENERAL.

2-2. This section contains installation and operating instructions for the Main Frame. The Main Frame has been factory tested and adjusted and is shipped in a ready-to-operate condition. However, no attempt should be made to install or operate the unit until the operator is thoroughly familiar with the contents of this section. Figure 2-1 is an outline dimension drawing of the Main Frame.

2-3. INSTALLATION.

2-4. To install the Main Frame in a standard 19-inch relay rack, place the Main Frame in the position desired and secure the front panel to vertical members of the rack with four screws. Then, determine whether the supply voltage is 110 or 220 volts ac and set the 110 VAC - 220 VAC switch on the rear of the unit to the appropriate position. If the power is 110 volts ac, fuse F1 should have a rating of 3/4 amperes (Delay). However, when a source of 220 volts ac is used, the 3/4 ampere fuse must be replaced by one with a 3/8 ampere (Delay) rating.

2-5. After the Main Frame has been installed in the rack, and power considerations have been accomplished, connect the appropriate power cable supplied with the SSB-50 system between AC INPUT connector J6 on the rear of the Main Frame and connector J6 on the rear of the Model MF-50 Main Frame. To operate the Main Frame directly from the a-c source, an a-c line cord should be connected between the a-c receptacle on the rear of the Main Frame and the power source. Before operating the equipment, make sure that a shorting plug P10 is placed over connector J10.

2-6. OPERATION.

2-7. OPERATING CONTROLS, INDICATORS, AND CONNECTORS. The operating controls, indicators,

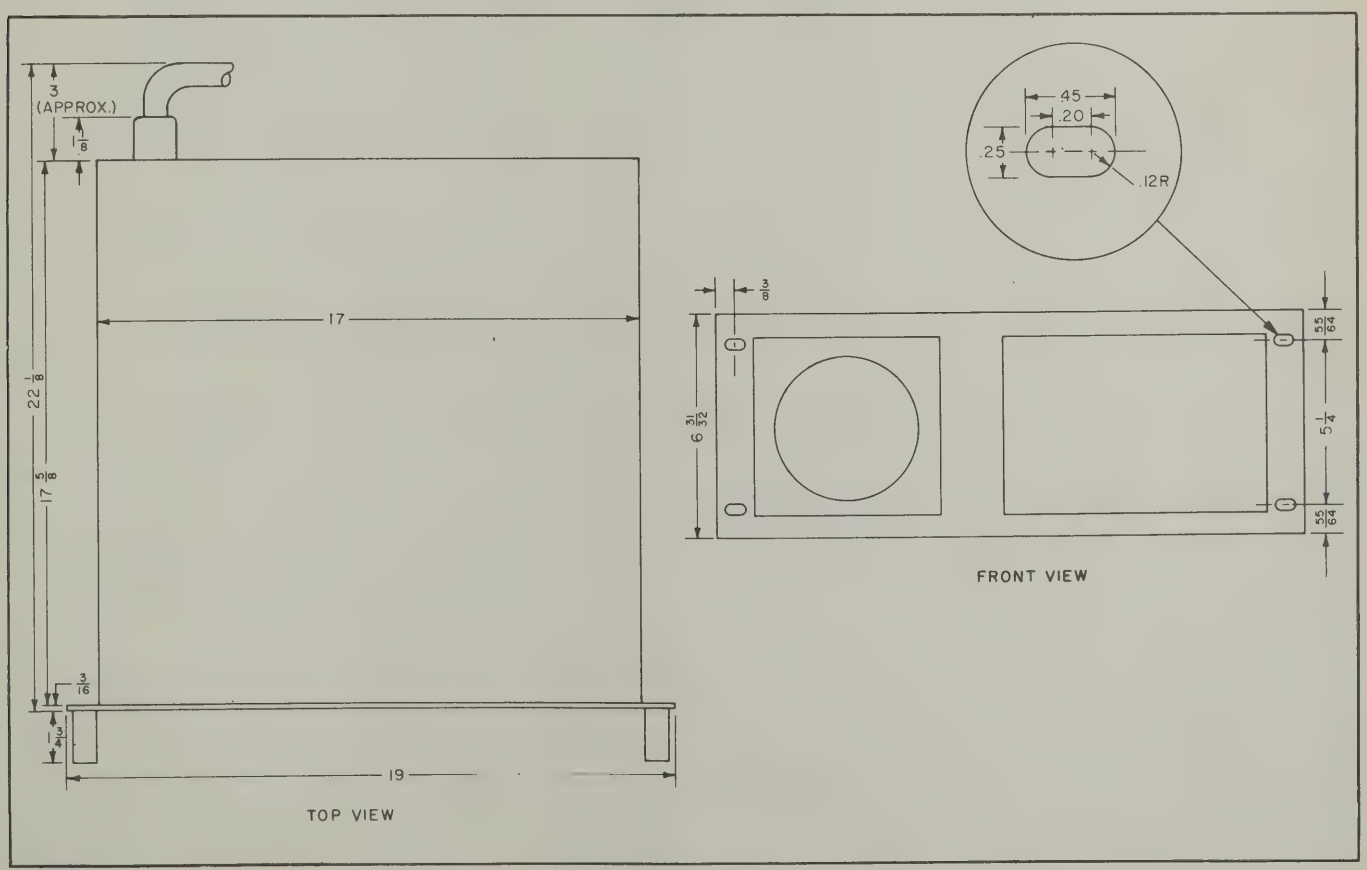


Figure 2-1. Outline Dimension Drawing, Main Frame

and connectors for the Main Frame are described in table 2-1 and shown in figure 2-2.

2-8. TURN ON PROCEDURES. To turn on the Main Frame, check that the equipment is set up properly in accordance with primary power requirements and that the CA-5 Panalyzor is properly inserted in the cavity; then turn the INTENSITY control fully counter-clockwise and the SCALE ILLUMINATION control clockwise until the CRT graticule illuminates. Operating voltages are now applied to all circuits of the Main Frame and associated plug-in module. The power indicator light should be illuminated. Wait 30 seconds, then slowly turn the INTENSITY control clockwise and observe a trace on the CRT. Adjust the INTENSITY and FOCUS controls to obtain the desired trace.

2-9. OPERATING PROCEDURES. Actual operation of the Main Frame is secondary to and dependent on the CA-5 Panalyzor; also the function to be performed. In general, to obtain a sharp, clear trace, a thorough understanding of the functions of the controls on the Main Frame (table 2-1) will suffice.

2-10. PACKAGING INSTRUCTIONS.

2-11. The following packaging instructions provide information for short-term and long-term storage and shipment of the Main Frame.

2-12. SHORT-TERM PACKAGING. For short-term packaging, the Main Frame should be enclosed in a polyethylene bag and placed in a suitable carton for protection. The carton should be stored in a clean and moisture-free area. All accessories and literature should be securely fastened to the equipment in order to prevent loss.

2-13. LONG-TERM PACKAGING AND PACKAGING FOR SHIPMENT. Figure 2-3 illustrates the packaging procedure for the Main Frame.

TABLE 2-1. OPERATOR'S CONTROLS, INDICATORS, AND CONNECTORS

Index No. (figure 2-2)	Reference Designation	Control or Indicator	Function
1	V1	Cathode ray tube	Provides means for visually displaying information selected by the CA-5.
2	R3, S1	SCALE ILLUMINATION control	Combination switch and variable control. When turned clockwise from PWR OFF position (audible click can be heard), applies source power to operate unit. Further clockwise rotation increases brilliance of CRT graticule illumination lights.
3	R5	INTENSITY control	Controls brightness of display on CRT.
4	R7	FOCUS control	Controls sharpness and definition of display on CRT.
5	R8	HORIZ POS control	Controls horizontal position of display on CRT.
6	R9	H SIZE screwdriver adjustment	Controls horizontal size of display on CRT.
7	DS1	Power indicator light	Illuminates to indicate that power is applied to Main Frame and Module circuits.
8	R10	VERT. POS control	Controls vertical position of display on CRT.
9	R4	V SIZE screwdriver adjustment	Controls vertical size of display on CRT.

(Cont'd)

TABLE 2-1. OPERATOR'S CONTROLS, INDICATORS, AND CONNECTORS (Cont'd)

Index No. (figure 2-2)	Reference Designation	Control or Indicator	Function
10	J9	X OUTOUT connector	Provides sawtooth sweep from the CA-5 to external equipment.
11	J7	Y OUTOUT connector	Couples sync output (from companion modules having sync capability) to external equipment. The CA-5 does not have this capability.
12	J8	SYNC OUTPUT connector	Couples sync output (from companion modules having sync capability) to external equipment. The CA-5 does not have this capability.
13	J6	AC INPUT connector	Connector through which a-c power is applied to the Main Frame.
14	J10	Accessory output connector	Provides signals for application to auxiliary test equipment.
15	S2	110 VAC-220 VAC switch	Permits either 110 or 220 vac operation.

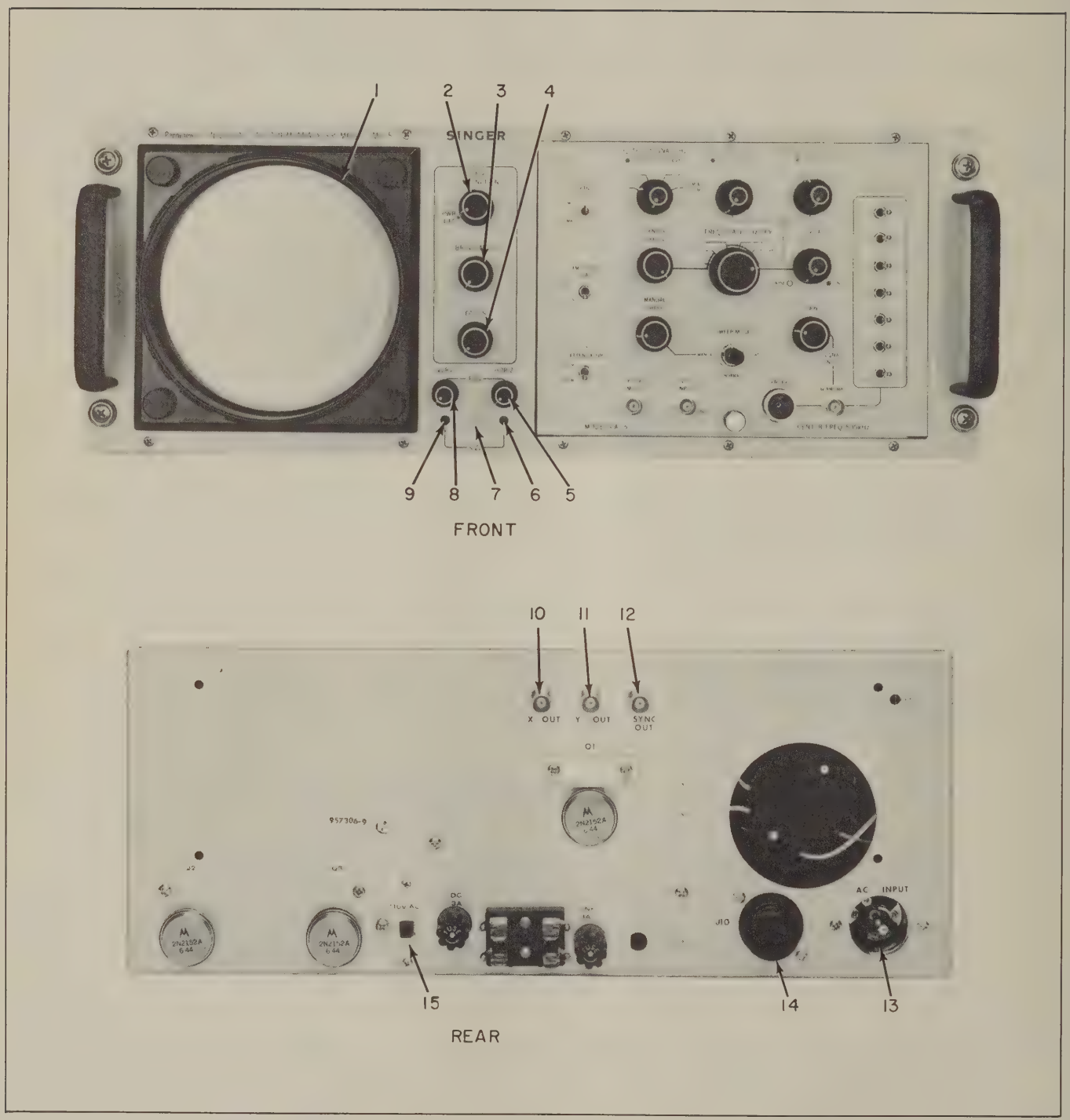


Figure 2-2. Operating Controls, Indicators and Connectors

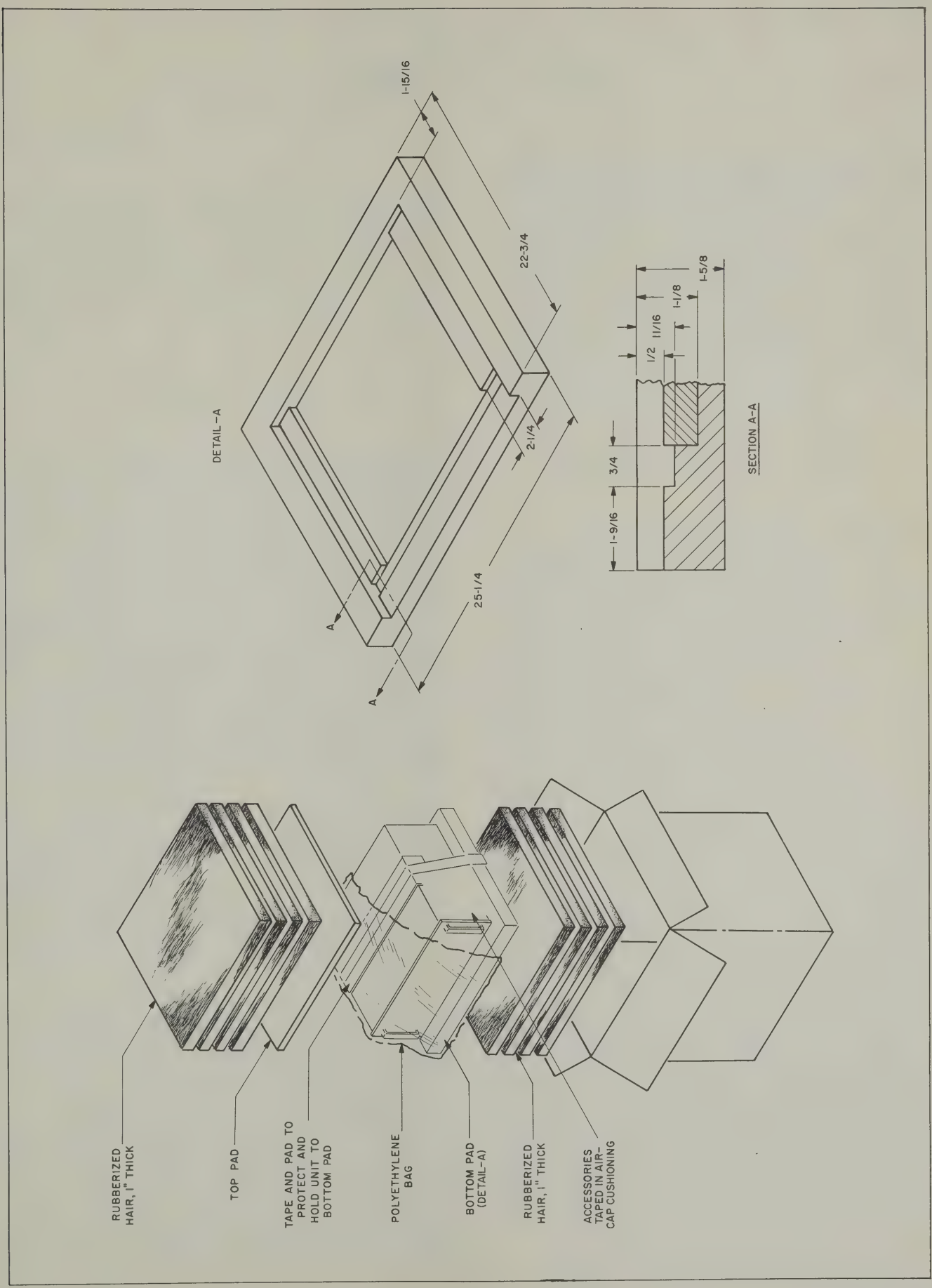


Figure 2-3. Packaging the Main Frame

SECTION III

THEORY OF OPERATION

3-1. GENERAL.

3-2. This section contains the theory of operation for the Main Frame. The Main Frame is an indicator with integral power supplies and deflection circuits. It operates in conjunction with the CA-5 Panalyzor plug-in module to display the level versus frequency plot for input signals to the CA-5. Operating power for the CA-5 is provided by the Main Frame.

3-3. BLOCK DIAGRAM ANALYSIS.

3-4. The horizontal and vertical deflection amplifiers (figure 3-1) provide the horizontal and vertical deflection for the CRT. The inputs to the horizontal deflection amplifier are a sawtooth sweep from the companion module through H SIZE control R9, and a dc level from HORIZ control R8 which controls horizontal sweep position. These two signals are amplified and applied to the horizontal deflection plates of CRT V1. The two inputs to the vertical deflection amplifier are the video input from the companion module through V SIZE control R4, and a d-c level from VERT POS control R10 which controls the vertical position. These two signals are amplified and applied to the vertical deflection plates of CRT V1. The horizontal and vertical deflection signals applied to the deflection plates of CRT V1 deflect the electron beam in such a manner as to provide a visual indication of the video signal from the companion module.

3-5. Main Frame also contains three buffer amplifiers. These amplifiers accept a sweep sync pulse, video, and a sawtooth sweep signal from the companion module. The signals are then amplified and furnished to output connectors J7, J8, and J9 as the Y OUT, SYNC OUT*, and X OUT signals, respectively. These outputs may be employed to drive external equipment used in conjunction with the Main Frame.

3-6. Input power of 110 volts or 220 volts ac is applied to the primary of power transformer T1. The secondary windings of transformer T1 are connected to the graticule lights, the +300-volt dc and +320-volt dc full-wave rectifier and filter, the filaments of CRT V1, and to the low voltage rectifier and regulator. The +320-volt dc full-wave rectifier and filter provides +300 volts operating power for the Main Frame vertical and horizontal deflection amplifiers. The input to the low voltage rectifier and regulator is rectified and regulated at +10 volts dc and coupled to a multivibrator. The multivibrator applies its output to the push-pull amplifier which drives the primary of power transformer T2. The secondary windings of transformer T2 are connected to the high voltage rectifier unit, the -11-volt dc rectifier and regulator, and the +21-volt dc rectifier and regulator. The high voltage rectifier unit provides +2200 and -2200 volts dc operating power for the CRT. The -11-volt dc and +21-volt dc rectifier and regulators furnish operating power for the companion module and Main Frame components. BRIGHTNESS control R5 controls the intensity of the CRT electron beam. Astigmatism control A1R25 and FOCUS control R7 provide for proper focusing of the electron beam.

*Sync output signal available only from companion modules having sync output. CA-5 does not have this capability.

3-7. DETAILED THEORY OF OPERATION (See Figure 5-1.)

3-8. +320-VOLT DC RECTIFIER. The +320-volt dc rectifier consists of diodes CR1 and CR2. These diodes together with one of the secondary windings of transformer T1 form a full-wave rectifier. Capacitors C1-A and C1-B serve to filter the rectified output. Resistors R2 and R11 form a voltage divider which provides two filtered voltage outputs of +320 volts and +300 volts. The +320-volt dc output provides power for astigmatism control A1R25. The +300-volt dc output provides operating power for the two vacuum tubes in deflection unit A2.

3-9. LOW VOLTAGE RECTIFIER AND REGULATOR. The low voltage rectifier and regulator consists of diodes CR3, CR4, and transistors Q3, A1Q3, A1Q4, A1Q5. Diodes CR3 and CR4 with one of the secondary winding of transformer T1 form a full-wave rectifier. The output, a positive dc voltage taken from the center tap of the transformer secondary, is applied through fuse F2 to the low voltage regulator. Transistors A1Q3 and A1Q4 form a differential amplifier. Diode A1CR3 establishes the voltage reference for the base of transistor A1Q3. A voltage divider consisting of resistors A1R12 and A1R15 and +10-volt adjustment potentiometer A1R13 establishes the voltage at the base of transistor A1Q4. Any variation in the full-wave rectifier output is sensed on the base of transistor A1Q4. This change results in an increase or decrease in current through common emitter resistor A1R14 which in turn changes the emitter-base biasing of transistor A1Q3. This change is coupled to the base of transistor A1Q5 from the collector of transistor A1Q3. Transistor A1Q5 is an emitter follower which controls the output current passed by series regulator transistor Q3. The regulated +10-volt dc output of Q3 is applied to multivibrator A1Q1 and A1Q2 and to the base of push-pull amplifier transistors Q1 and Q2.

3-10. MULTIVIBRATOR AND PUSH-PULL AMPLIFIER. The multivibrator and push-pull amplifier transistors A1Q1, A1Q2, Q1 and Q2 modulate or convert the +10-volt dc regulated output of the low voltage regulator to a-c. Transistors A1Q1 and A2Q2 form a free-running multivibrator. The free-running frequency is approximately 1400 Hz. Two 1400-Hz outputs, 180-degrees out of phase, are taken from the multivibrator. One output is applied to the base of push-pull amplifier Q1 and the other to the base of Q2. The regulated +10 volts dc is applied to the emitter of Q1 and Q2. Therefore Q1 and Q2 are switched alternately on and off at a 1400-Hz rate. The 1400-Hz alternating current output of transistors Q1 and Q2 is coupled to the primary of power transformer T2.

3-11. +21-VOLT DC RECTIFIER AND REGULATOR. The +21-volt dc rectifier and regulator consists of diodes CR5, CR6 and series regulator transistor Q4. Diodes CR5 and CR6 together with one of the secondary windings of transformer T2 form a full-wave rectifier. Resistor A1R16 and diode A1CR4 provide a reference voltage to the base of series regulator Q4 which increases or decreases conduction to offset the change. The output is a regulated +21 volts dc.

3-12. -11-VOLT DC RECTIFIER AND REGULATOR. The -11-volt dc rectifier and regulator consists of diodes CR7, CR8, transistors Q5, A1Q7, A1Q9, and A1Q10. Diodes CR7 and CR8 together with one of the secondary windings of power transformer T2 form a full-wave rectifier. Transistors A1Q9 and A1Q10 form a differential amplifier to sense any changes in the output voltage. These changes are amplified and applied to the base of emitter follower A1Q7 which controls series regulator Q5. The output is set to -11 volts dc by -11 V adjustment potentiometer A1R22.

3-13. HIGH VOLTAGE RECTIFIER. The high voltage rectifier unit consists of two half-wave voltage doublers. One voltage doubler, consisting of diodes A3CR1, A3CR2, and capacitors A3C1 and A3C2, produces a -2200-volt output for use by CRT V1. The other voltage doubler, consisting of diodes A3CR3 and A3CR4, and capacitors A3C3 and A3C4, produces a +2200-volt output for use by the CRT. Resistor R1 and R2 are high voltage bleeder resistors for the +2200-volt doubler.

3-14. DEFLECTION CIRCUITS. The deflection circuits comprise a horizontal deflection circuit and a vertical deflection circuit. The horizontal deflection circuit consists of dual triode A2V2. Triode A2V2 is a differential amplifier that amplifies the sawtooth sweep signal from the companion module developed across H SIZE potentiometer R9. The horizontal sweep position is determined by the setting of HORIZ POS potentiometer R8. The outputs of both halves of the dual triode A2V2 are applied to the horizontal deflection plates of CRT V1. The vertical deflection circuit consists of transistors A2Q1, A2Q2 and dual triode A2V1. Transistors A2Q1 and A2Q2 form a differential amplifier that amplifies the video from the companion module developed across V SIZE potentiometer R4. The vertical sweep position is determined by the setting of VERT POS control R10. The outputs of A2Q1 and A2Q2 are applied to the control grids of dual triode A2V2. The amplified outputs of both halves of the dual triode A2V1 are then applied to the vertical deflection plates of CRT V1.

3-15. BUFFER AMPLIFIERS. The buffer amplifiers consist of transistors A2Q3, A2Q4, A2Q5, and A2Q6. Transistors A2Q3 and A2Q4 form a unity gain amplifier that amplifies the video signal from the companion module and applies it to the Y OUT connector J7. Transistor A2Q5 is normally at cutoff and is driven into conduction by the negative sweep sync pulse from the companion module*. The amplified positive sweep sync pulse from the collector of A2Q5 is applied to SYNC OUT connector J8. Diode A2CR1 is a clamp that improves the shape of the applied sweep sync pulse. Transistor A2Q6 is an emitter follower that amplifies the sawtooth sweep from the companion module and applies it to X OUT connector J9.

3-16. POWER DISTRIBUTION.

3-17. Figure 3-2 is the operating power distribution diagram for the Main Frame. Both the regulated -11 volts dc and regulated +21 volts dc are coupled to the companion module connector to supply operating power for the companion module. In addition to the regulated -11 and +21 volts dc power, +300 volts dc is available to the deflection unit A2 and +320 volts dc is available to the astigmatism control located in regulator unit A1 from the +300/+320-volt dc rectifier.

* The CA-5 does not produce a sync output signal.

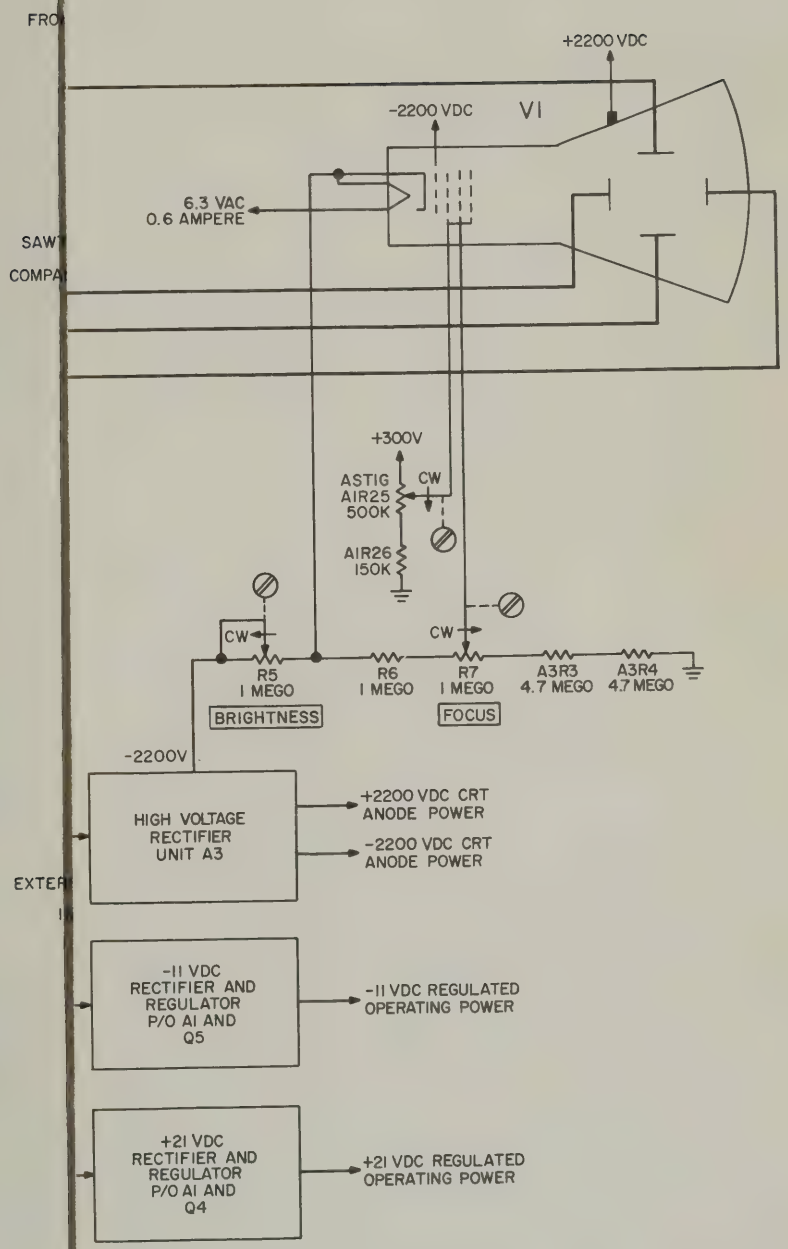


Figure 3-1. Block Diagram, Main Frame

3-10. MULTIVIBRATOR AND PUSH-PULL AMPLIFIER. The multivibrator and push-pull amplifier transistors A1Q1, A1Q2, Q1 and Q2 modulate or convert the +10-volt dc regulated output of the low voltage regulator to a-c. Transistors A1Q1 and A2Q2 form a free-running multivibrator. The free-running frequency is approximately 1400 Hz. Two 1400-Hz outputs, 180-degrees out of phase, are taken from the multivibrator. One output is applied to the base of push-pull amplifier Q1 and the other to the base of Q2. The regulated +10 volts dc is applied to the emitter of Q1 and Q2. Therefore Q1 and Q2 are switched alternately on and off at a 1400-Hz rate. The 1400-Hz alternating current output of transistors Q1 and Q2 is coupled to the primary of power transformer T2.

3-11. +21-VOLT DC RECTIFIER AND REGULATOR. The +21-volt dc rectifier and regulator consists of diodes CR5, CR6 and series regulator transistor Q4. Diodes CR5 and CR6 together with one of the secondary windings of transformer T2 form a full-wave rectifier. Resistor A1R16 and diode A1CR4 provide a reference voltage to the base of series regulator Q4 which increases or decreases conduction to offset the change. The output is a regulated +21 volts dc.

3-12. -11-VOLT DC RECTIFIER AND REGULATOR. The -11-volt dc rectifier and regulator consists of diodes CR7, CR8, transistors Q5, A1Q7, A1Q9, and A1Q10. Diodes CR7 and CR8 together with one of the secondary windings of power transformer T2 form a full-wave rectifier. Transistors A1Q9 and A1Q10 form a differential amplifier to sense any changes in the output voltage. These changes are amplified and applied to the base of emitter follower A1Q7 which controls series regulator Q5. The output is set to -11 volts dc by -11 V adjustment potentiometer A1R22.

3-13. HIGH VOLTAGE RECTIFIER. The high voltage rectifier unit consists of two half-wave voltage doublers. One voltage doubler, consisting of diodes A3CR1, A3CR2, and capacitors A3C1 and A3C2, produces a -2200-volt output for use by CRT V1. The other voltage doubler, consisting of diodes A3CR3 and A3CR4, and capacitors A3C3 and A3C4, produces a +2200-volt output for use by the CRT. Resistor R1 and R2 are high voltage bleeder resistors for the +2200-volt doubler.

3-14. DEFLECTION CIRCUITS. The deflection circuits comprise a horizontal deflection circuit and a vertical deflection circuit. The horizontal deflection circuit consists of dual triode A2V2. Triode A2V2 is a differential amplifier that amplifies the sawtooth sweep signal from the companion module developed across H SIZE potentiometer R9. The horizontal sweep position is determined by the setting of HORIZ POS potentiometer R8. The outputs of both halves of the dual triode A2V2 are applied to the horizontal deflection plates of CRT V1. The vertical deflection circuit consists of transistors A2Q1, A2Q2 and dual triode A2V1. Transistors A2Q1 and A2Q2 form a differential amplifier that amplifies the video from the companion module developed across V SIZE potentiometer R4. The vertical sweep position is determined by the setting of VERT POS control R10. The outputs of A2Q1 and A2Q2 are applied to the control grids of dual triode A2V2. The amplified outputs of both halves of the dual triode A2V1 are then applied to the vertical deflection plates of CRT V1.

3-15. BUFFER AMPLIFIERS. The buffer amplifiers consist of transistors A2Q3, A2Q4, A2Q5, and A2Q6. Transistors A2Q3 and A2Q4 form a unity gain amplifier that amplifies the video signal from the companion module and applies it to the Y OUT connector J7. Transistor A2Q5 is normally at cutoff and is driven into conduction by the negative sweep sync pulse from the companion module*. The amplified positive sweep sync pulse from the collector of A2Q5 is applied to SYNC OUT connector J8. Diode A2CR1 is a clamp that improves the shape of the applied sweep sync pulse. Transistor A2Q6 is an emitter follower that amplifies the sawtooth sweep from the companion module and applies it to X OUT connector J9.

3-16. POWER DISTRIBUTION.

3-17. Figure 3-2 is the operating power distribution diagram for the Main Frame. Both the regulated -11 volts dc and regulated +21 volts dc are coupled to the companion module connector to supply operating power for the companion module. In addition to the regulated -11 and +21 volts dc power, +300 volts dc is available to the deflection unit A2 and +320 volts dc is available to the astigmatism control located in regulator unit A1 from the +300/+320-volt dc rectifier.

* The CA-5 does not produce a sync output signal.

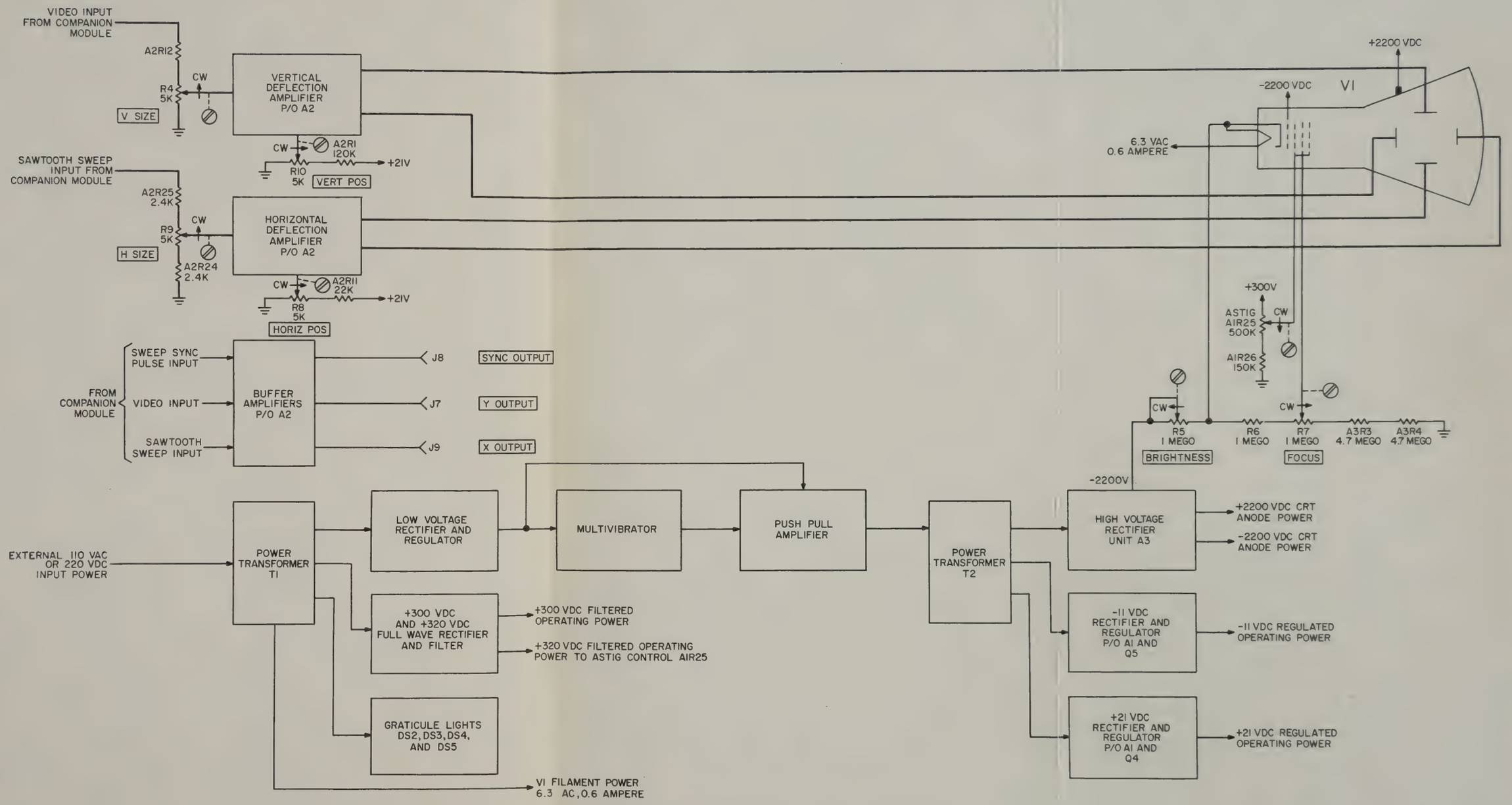


Figure 3-1. Block Diagram, Main Frame

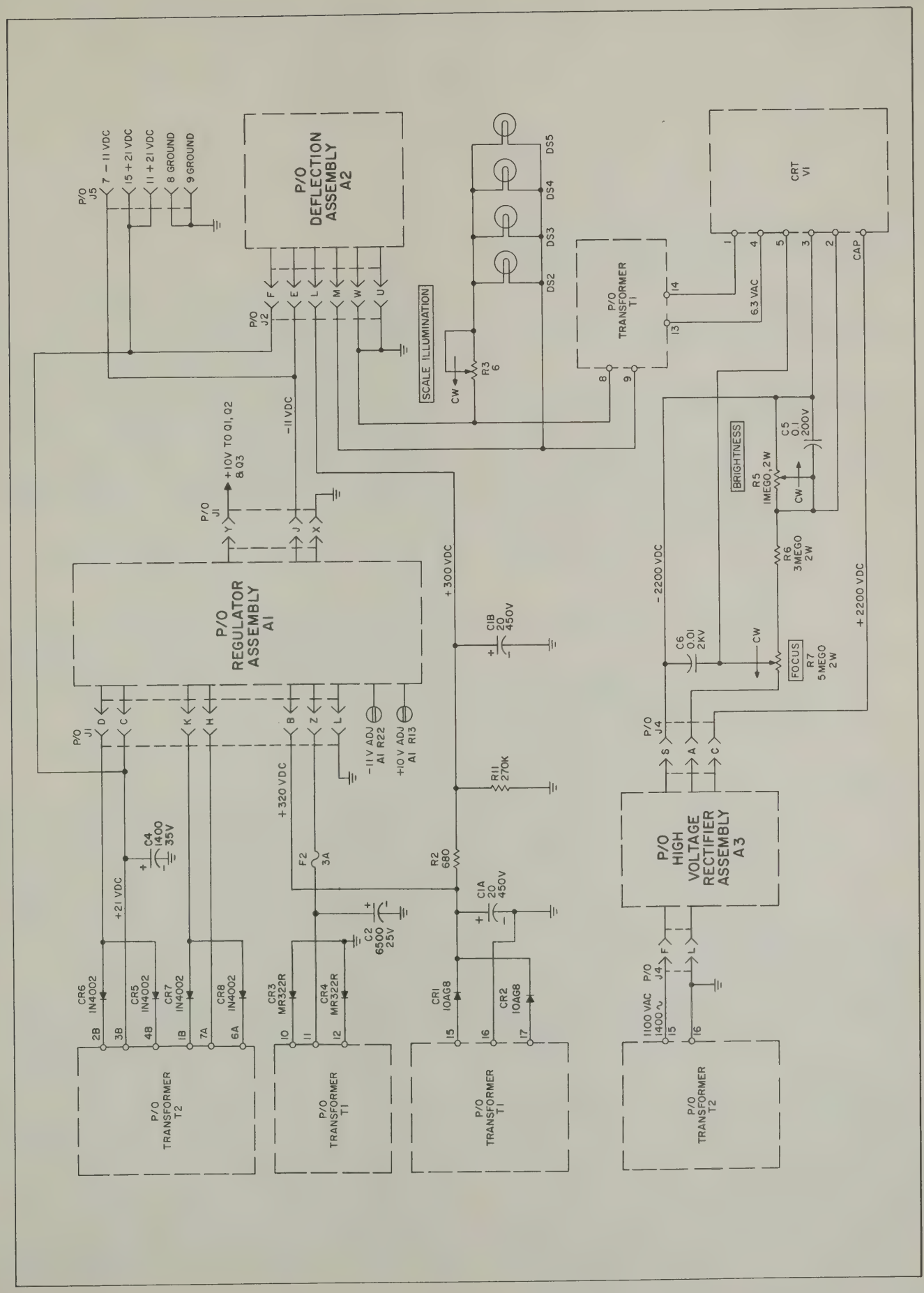


Figure 3-2. Operating Power Distribution Diagram, Main Frame

SECTION IV

MAINTENANCE

4-1. GENERAL.

4-2. This section contains maintenance instructions for the Main Frame. No attempt should be made to repair internal components or make adjustments until the operator is thoroughly familiar with the information contained in this section. The performance of the Main Frame may be checked using the minimum performance standards checks provided to determine whether the equipment is operating properly. A systematic troubleshooting procedure to isolate troubles in the Main Frame and an adjustment procedure to restore the equipment to proper operating condition after the required repairs have been effected are also included in this section.

4-3. TEST EQUIPMENT REQUIRED.

4-4. The test equipment required for maintenance of the Main Frame is listed in table 4-1. Equipment having similar characteristics may be substituted for those listed in the table.

4-5. PRELIMINARY INSPECTION.

4-6. Preliminary inspection of the equipment is performed on the Main Frame without operating power applied. This type of check is designed to detect conditions that might otherwise lead to a breakdown. Frequent causes of premature failure are overheating due to improper ventilation, accumulation of dust and dirt and/or loose connections and fittings. Inspection is carried out with emphasis on finding evidence of these conditions.

4-7. COMPONENT LOCATION. The location of components mentioned in the inspection routines, adjustment and troubleshooting procedures are illustrated in figures 4-1 and 4-2. Since the component reference designations are screened on the printed circuit cards, no illustrations are provided.

4-8. INSPECTION ROUTINES. Table 4-2 lists the preliminary inspection routine for the equipment.

4-9. MINIMUM PERFORMANCE STANDARDS.

4-10. The minimum performance standards checks listed in table 4-3 provide a rapid, convenient means of determining if the Main Frame is operating properly. These checks are performed with a CA-5 Panalyzor plugged into the Main Frame. The quality of these checks presupposes that the CA-5 is operating within acceptable limits.

4-11. SYSTEMATIC TROUBLE LOCALIZATION.

4-12. Systematic trouble localization (table 4-4) utilizes symptomatic troubleshooting techniques to localize troubles within the Main Frame to a stage or group of stages. Since some of the component board assemblies encompass more than one functional circuit, trouble localization is restricted not only to the assembly, but to the stage or group of stages that could result in the malfunction. This procedure is performed with a CA-5 mounted in the Main Frame.

4-13. ADJUSTMENT PROCEDURES.

4-14. Adjustment procedures for the Main Frame are given in paragraphs 4-17 through 4-22. In addition, procedures for the removal of the dust cover and subassemblies, when the procedure is not obvious, are included.

4-15. DUST COVER REMOVAL. To remove the Main Frame dust covers, proceed as follows:

a. Remove flat head screws securing top and bottom dust covers to chassis.

b. Remove top and bottom dust covers.

4-16. SUBASSEMBLY REMOVAL. To remove the Main Frame subassemblies, proceed as follows:

a. Remove high voltage rectifier A3 component board by removing one screw on rear of unit and withdrawing the board from chassis connector by pulling to the left.

b. Remove regulator unit A1 component board by removing two screws on rear of module compartment wall, and withdrawing the board from chassis connector by pulling straight up.

c. Remove deflection unit A2 component board by removing two screws from front chassis connector bracket and sliding connector forward to disconnect it from board. Slide board forward to withdraw it from rear chassis connector.

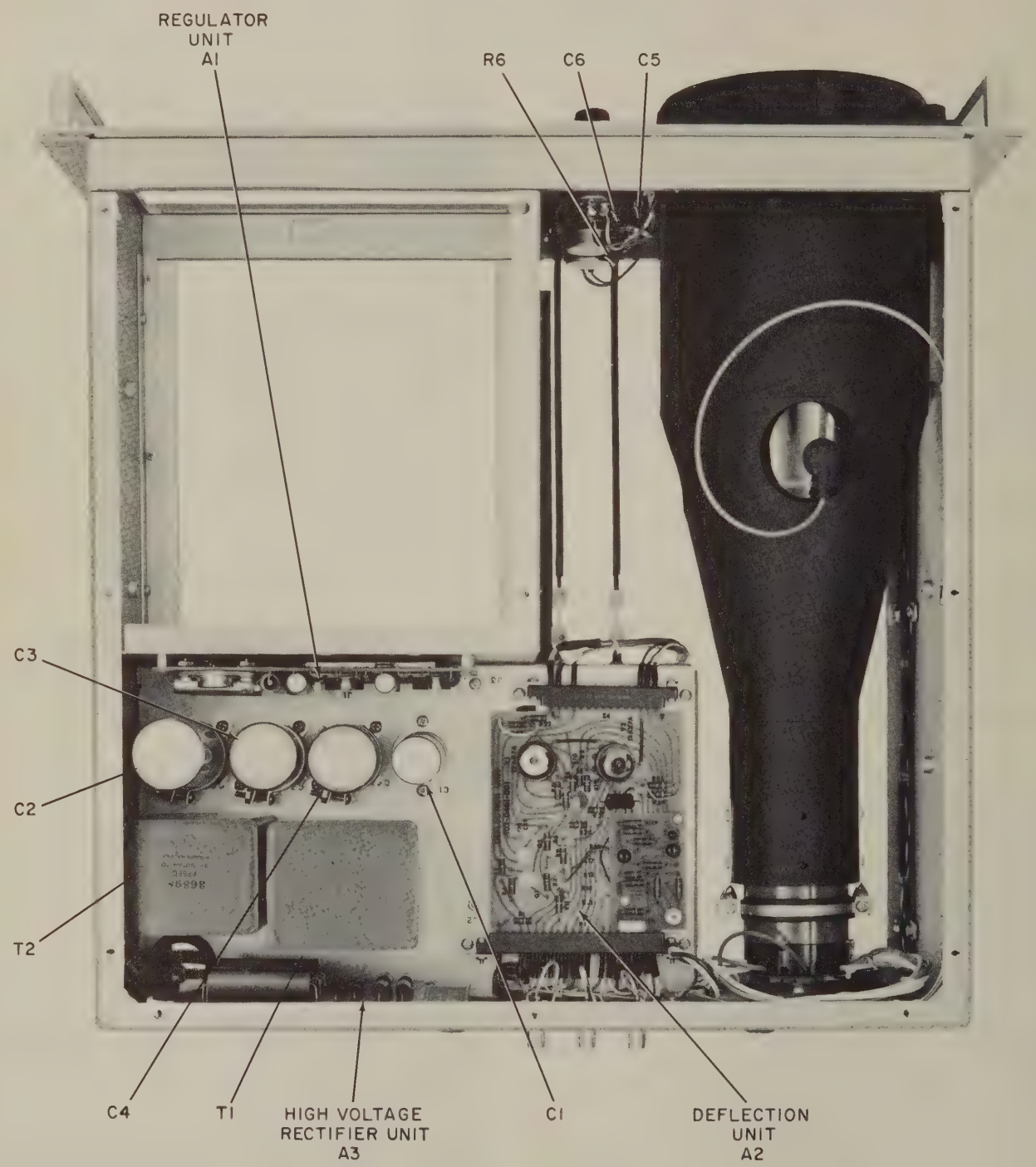


Figure 4-1. Main Frame, Top View

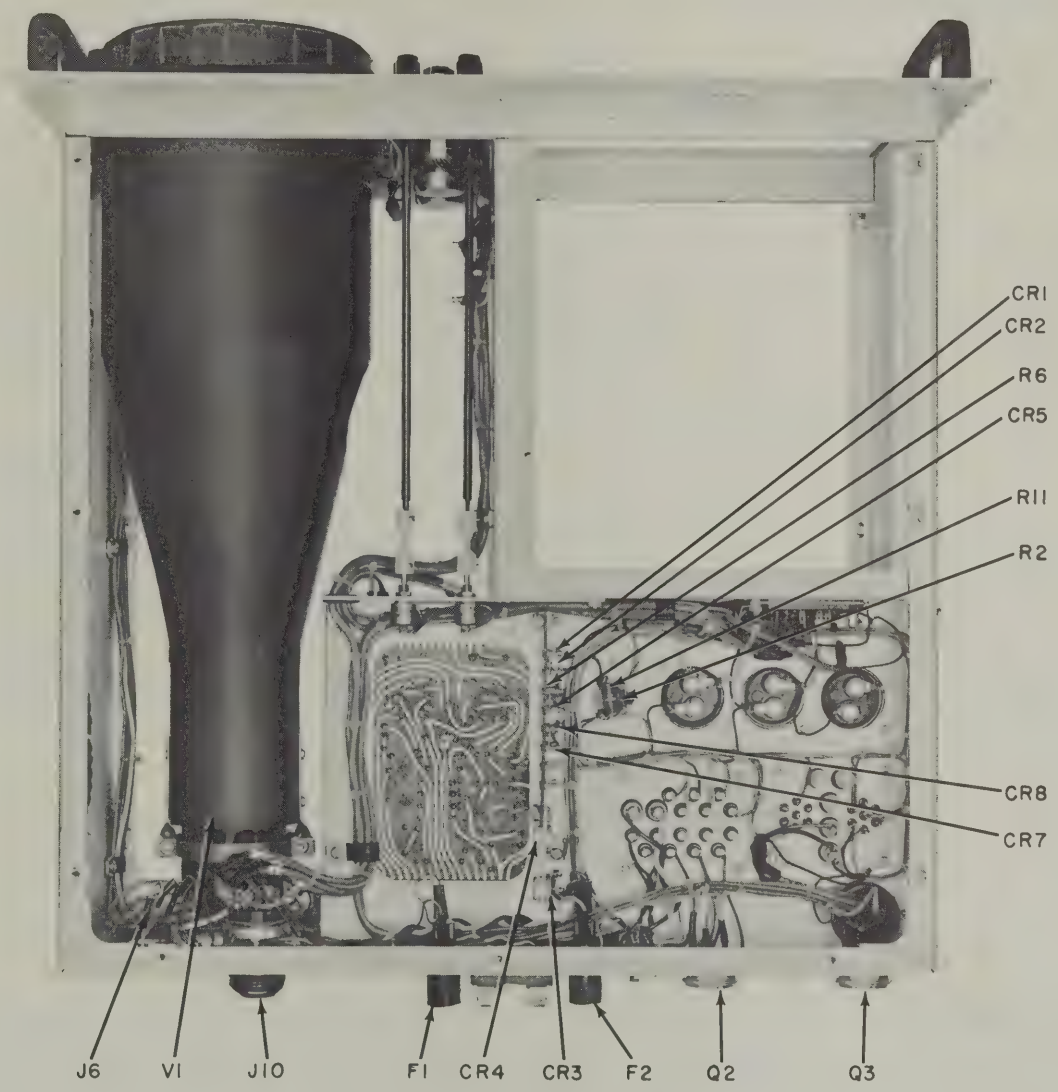


Figure 4-2. Main Frame, Bottom View

TABLE 4-1. TEST EQUIPMENT REQUIRED

Type of Equipment	Recommended Mfr. Name and Model No.	Application
VTVM	Ballantine Model 320A	Voltage and resistance measurements
VOM	Simpson 260	Voltage and resistance measurements
Digital VTVM	Non-Linear Systems Series 4800	-11-volt regulator adjustment
Oscilloscope	Tektronix 531A with Type L Plug-in unit	General waveform analysis

TABLE 4-2. PRELIMINARY INSPECTION ROUTINES

Item	Inspect For	Corrective Action
Connector at rear wall of module cavity	Looseness, bent or corroded contacts, signs of arcing	Clean contacts with cloth moistened with cleaning solvent trichloroethylene or equivalent. Replace jack if damaged or deeply corroded.
Main Frame and front panel	Dirt and corrosion	Clean with cloth moistened with cleaning solvent trichloroethylene or equivalent.
Knobs, screws, connectors, clamps	Looseness	Tighten using appropriate torque so as not to strip threads.
Switches	Looseness	Tighten mounting screws or nut.
Wiring	Looseness	Resolder, recable, or reclamp.
	Frayed, worn, or missing insulation	Replace as required.
Solder joints	Loose or cold solder connections; corrosion	Clean carefully and resolder, using recommended soldering iron.
Printed circuit boards	Mounting looseness	Replace mating plug if required.
	Loose components	Resolder loose components.
Resistors	Cracks, chipping, blistering, discoloration, and other signs of overheating	Replace with exact match of original. **Note** Ensure that overheating is not due to other defective components.

(Cont'd)

TABLE 4-2. PRELIMINARY INSPECTION ROUTINES (Cont'd)

Item	Inspect For	Corrective Action
Capacitors	Leaks, bulges, signs of aging	Replace capacitor.
	Loose mounting bracket	Tighten nuts or screws holding bracket.
Switch contacts	Dirt, dust, and/or corrosion	Clean with cloth, aerosol spray, syringe or camel-hair brush using trichloro-ethylene or equivalent.
	Bent or broken contacts	Replace switch wafer or assembly.
Transistors	Looseness	Tighten clips and tension leads.
Cathode ray tube	Dirt, dust, or signs of arcing around high voltage lead	Clean with a dry cloth.
	Dirt or dust on scope face or graticule	Clean with damp cloth.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS

Check	Purpose	Test Procedure	Acceptable Indication
1	To check operation of power supplies.	Set 110VAC-220VAC switch on rear of Main Frame to 110 VAC. Set the SCALE ILLUMINATION control fully counterclockwise. Connect Main Frame power cable to an a-c source of 90 to 130 volts and check that fuse F1 is of proper rating. Rotate SCALE ILLUMINATION switch fully clockwise.	Power indicator light and CRT graticule illumination lights illuminate. After approximately 30 seconds, a trace is visible on CRT.
2	To check operation of intensity control.	Slowly vary INTENSITY control through its entire range, then position to obtain desired intensity.	Brilliance of sweep on CRT varies, increasing with clockwise rotation.
3	To check operation of FOCUS control.	Slowly vary FOCUS control through its entire range, then position to obtain optimum focus.	Sweep can be focused to satisfaction.
4	To check operation of deflection circuits.	Slowly vary setting of VERT. POS. control through its entire range, then set to obtain desired vertical position of sweep.	Sweep moves up and down on CRT, moving upward with clockwise rotation.

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS (Cont'd)

Check	Purpose	Test Procedure	Acceptable Indication
5	To check operation of deflection circuits.	Slowly vary setting of HORIZ POS control through its entire range, then set to obtain desired vertical position of sweep.	Sweep moves to left and right on CRT in same direction as rotation of control.
6	To check operation of deflection circuits.	Refer to the CA-5 manual to provide a test signal to Main Frame.	Test signal appears on sweep.
7	To check operation of remote display circuits.	Connect oscilloscope to X OUT connector on rear of unit.	Sawtooth waveform of at least 3 volts peak-to-peak appears on oscilloscope.
8	To check operation of remote display circuits.	Connect oscilloscope to Y OUT connector on rear of unit.	Test signal (1.4v, approx., for full scale) similar to that in check 7 appears on oscilloscope.
9*	To check operation of remote display circuits.	Connect oscilloscope to SYNC OUT connector on rear of unit.	Pulse (+3v min.) appears on oscilloscope.

*Sync output signal not available when CA-5 is operating in conjunction with MF-5.

TABLE 4-4. SYSTEMATIC TROUBLE LOCALIZATION

Step No.	Symptom	Test Procedure	If Indication Is Normal	If Indication Is Abnormal
1	Power indicator light and CRT graticule illumination lights do not illuminate.	Shut off power and check fuse F1.	Check switch S1.	Replace F1.
2	No trace or spot visible on CRT. Power indicator light is illuminated.	a. Using voltmeter, check for presence of +14 to +18 volts dc between pin Z of J1 (plus lead) and chassis (minus lead).	Go to step b.	Check CR3, CR4, and F2.
		b. Using voltmeter, check for presence of +10 volts dc between pin K of J1 (plus lead) and chassis (minus lead).	Go to step c.	Troubleshoot A1Q3, A1Q4, and A1Q5 on regulator unit and also Q3.
		c. Using oscilloscope, check for 20 volt peak-to-peak square wave between collector of Q1 or Q2 and chassis.	Go to step d.	Troubleshoot A1Q1 and A1Q2 on regulator unit.

(Cont'd)

TABLE 4-4. SYSTEMATIC TROUBLE LOCALIZATION (Cont'd)

Step No.	Symptom	Test Procedure	If Indication Is Normal	If Indication Is Abnormal
2 (Cont'd)		d. Using voltmeter, check for presence of +21 volts dc (approximately) between pin 15 of J5 (plus lead) and chassis (minus lead).	Go to step e.	Troubleshoot series regulator Q4. Check CR5, CR6, and A1CR4.
		e. Using voltmeter, check for presence of -11 volts dc between pin 7 of J5 (minus lead) and chassis (plus lead).	Go to step f.	Troubleshoot Q5, and A1Q7, A1Q9, and A1Q10 on regulator unit.
		f. Using voltmeter, check for presence of +300 volts dc between pin L of J2 (plus lead) and chassis (minus lead). **WARNING** EXERCISE EXTREME CARE IN PERFORMING STEPS G AND H. VOLTAGES DANGEROUS TO LIFE ARE PRESENT.	Go to step g.	Check CR1 and CR2.
		g. Using voltmeter, check for -2200 volts dc (approximately) between clockwise end of INTENSITY control R5 (minus lead) and chassis (plus lead).	Go to step h.	Check A3CR1 and A3CR2 in high voltage rectifier unit.
		h. Using voltmeter, check for presence of +2200 volts dc (approximately) between second anode connector CP1 (plus lead) and chassis (minus lead).	CRT V1 probably defective.	Check A3CR3 and A3CR4 on high voltage rectifier unit.
3	Intensity or focus of CRT display cannot be controlled.	a. Using voltmeter, check for presence of +320 volts dc between pin B of J1 (plus lead) and chassis (minus lead).	Go to step b.	Check CR1 and CR2.

(Cont'd)

TABLE 4-4. SYSTEMATIC TROUBLE LOCALIZATION (Cont'd)

Step No.	Symptom	Test Procedure	If Indication Is Normal	If Indication Is Abnormal
3 (Cont'd)		b. Shut off power and check resistance of INTENSITY control R5, R6, and FOCUS control R7. Also check C5, C6, A3CR3, and A3R4.	CRT defective.	Replace defective component.
4	Trace cannot be positioned vertically on CRT. No vertical deflection on CRT (no video).	Turn off power and check resistance of R4, R10, and A2R1.	Troubleshoot A2Q1, A2Q2, and A2V1 on deflection unit.	Replace any component found defective.
5	Trace cannot be positioned horizontally on CRT; or stationary spot on CRT.	Turn off power and check resistance of R8, R9, and A2R11.	Troubleshoot stage A2V2.	Replace defective component.
6	No sawtooth waveform at X OUT connector J9.	Turn off power and check resistance of A2R27.	Troubleshoot A2Q6 on deflection unit.	Replace defective component.
7	No video at Y OUT connector J7.	Turn off power and check resistance of A2R15.	Troubleshoot A2Q3 and A2Q4 on deflection unit.	Replace defective component.
8	No pulses present at SYNC OUT connector J8 when companion module employed has sync capability.	Turn off power and check A2C2 and A2R23 are not shorted or open.	Troubleshoot A2Q5 on deflection unit.	Replace defective component.

4-17. PRELIMINARY PROCEDURES. To set up the Main Frame for adjustment, proceed as follows:

a. Set all power switches to the off position and disconnect power from the Main Frame.

b. Remove the Main Frame from the rack.

c. Remove the Main Frame top and bottom dust covers following the procedure outlined in paragraph 4-15.

d. Connect the companion module to the Main Frame by means of provided cable.

e. Connect power to the Main Frame and turn on power switch. Allow 15 minutes for warm-up and stabilization before making adjustment.

4-18. +10V ADJUSTMENT A1R13. To perform the +10V adjustment procedure, proceed as follows:

a. Connect the Simpson 260 Voltmeter between chassis ground (minus lead) and positive terminal of A1C5 (plus lead).

b. Adjust potentiometer A1R13 to obtain a reading of +10.0 volts dc on the Simpson 260 voltmeter.

4-19. -11V ADJUSTMENT A1R22. To perform the -11V adjustment procedure, proceed as follows:

a. Connect the Non-Linear Systems Series 4800 digital voltmeter between pin 7 (minus lead) of connector J5 and chassis (plus lead).

b. Adjust potentiometer A1R22 to obtain a reading of -11.0±0.05 volts dc on the Non-Linear Systems Series 4800 digital voltmeter.

4-20. ASTIGMATISM ADJUSTMENT A1R25. To perform the astigmatism adjustment, proceed as follows:

a. Display test signal on the CRT screen by means of the companion module.

b. Adjust the FOCUS control for optimum focusing of the electron spot.

c. Adjust astigmatism potentiometer A1R25 to obtain uniform focus of the complete length of the scan.

4-21. H SIZE R9. To perform the H SIZE R9 adjustment, proceed as follows:

a. Adjust H SIZE potentiometer R9 to obtain a trace extending approximately 1/8 inch beyond each end of the engraved graticule markings.

b. Readjust HORIZ POS potentiometer R8 as required to keep trace centered while adjusting size.

Note

For more accurate adjustments, refer to the CA-5 instruction manual.

4-22. V SIZE R4. To perform V SIZE R4 adjustment, refer to the CA-5 instruction manual.

4-23. TYPICAL VOLTAGE MEASUREMENTS.

4-24. Typical voltage measurements for the Main Frame are included in figure 5-1. These typical voltage measurements were obtained with a Simpson 260 voltmeter under the following conditions:

a. Associated plug-in module connected to the Main Frame and no signal applied to module.

b. All controls set to their normal operating points.

SECTION V

SCHEMATIC DIAGRAMS

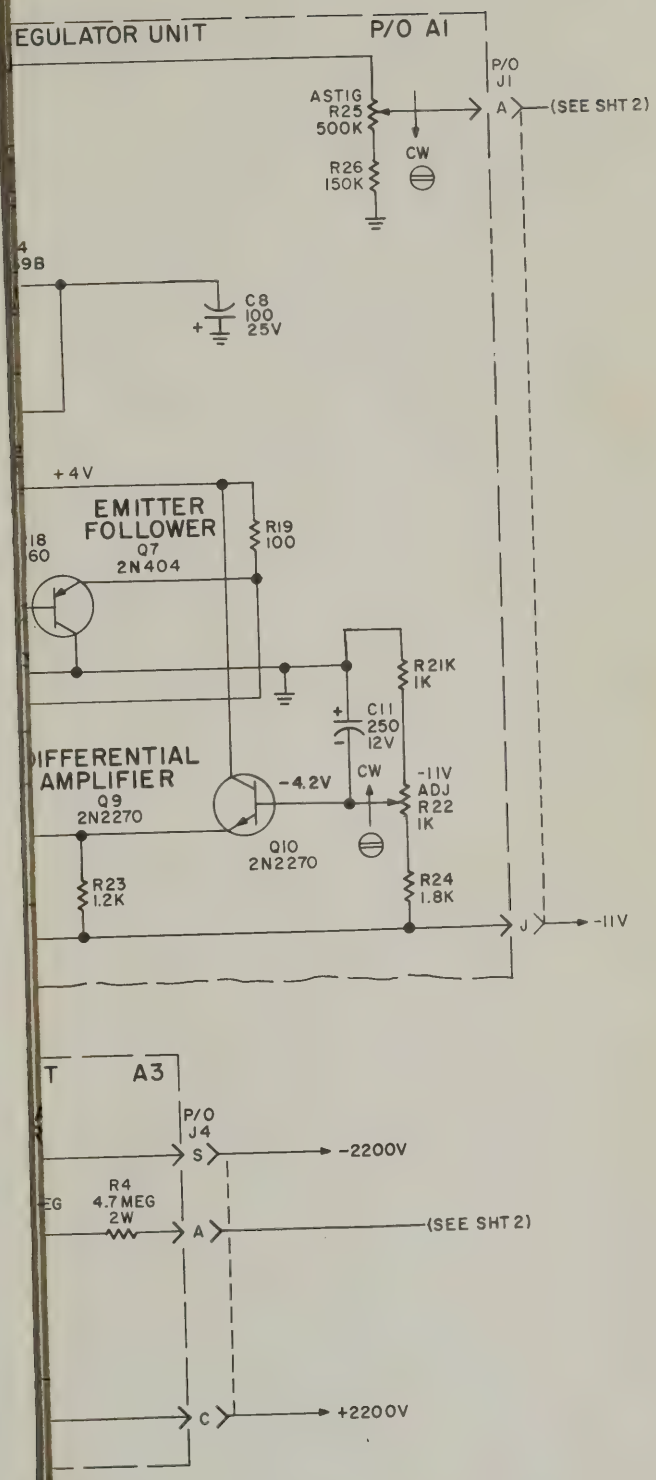


Figure 5-1. Schematic Diagram, Main Frame (Sheet 1 of 2)

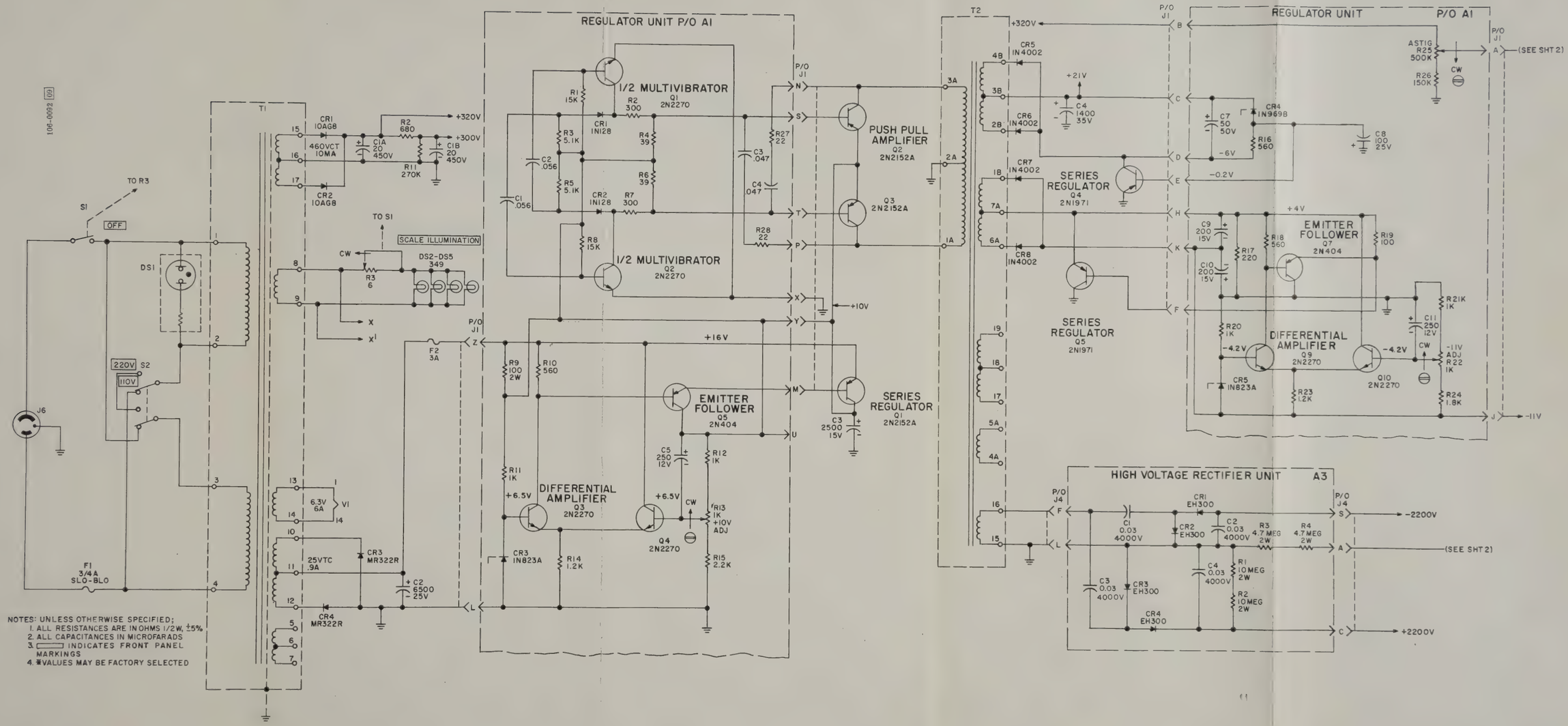


Figure 5-1. Schematic Diagram, Main Frame (Sheet 1 of 2)

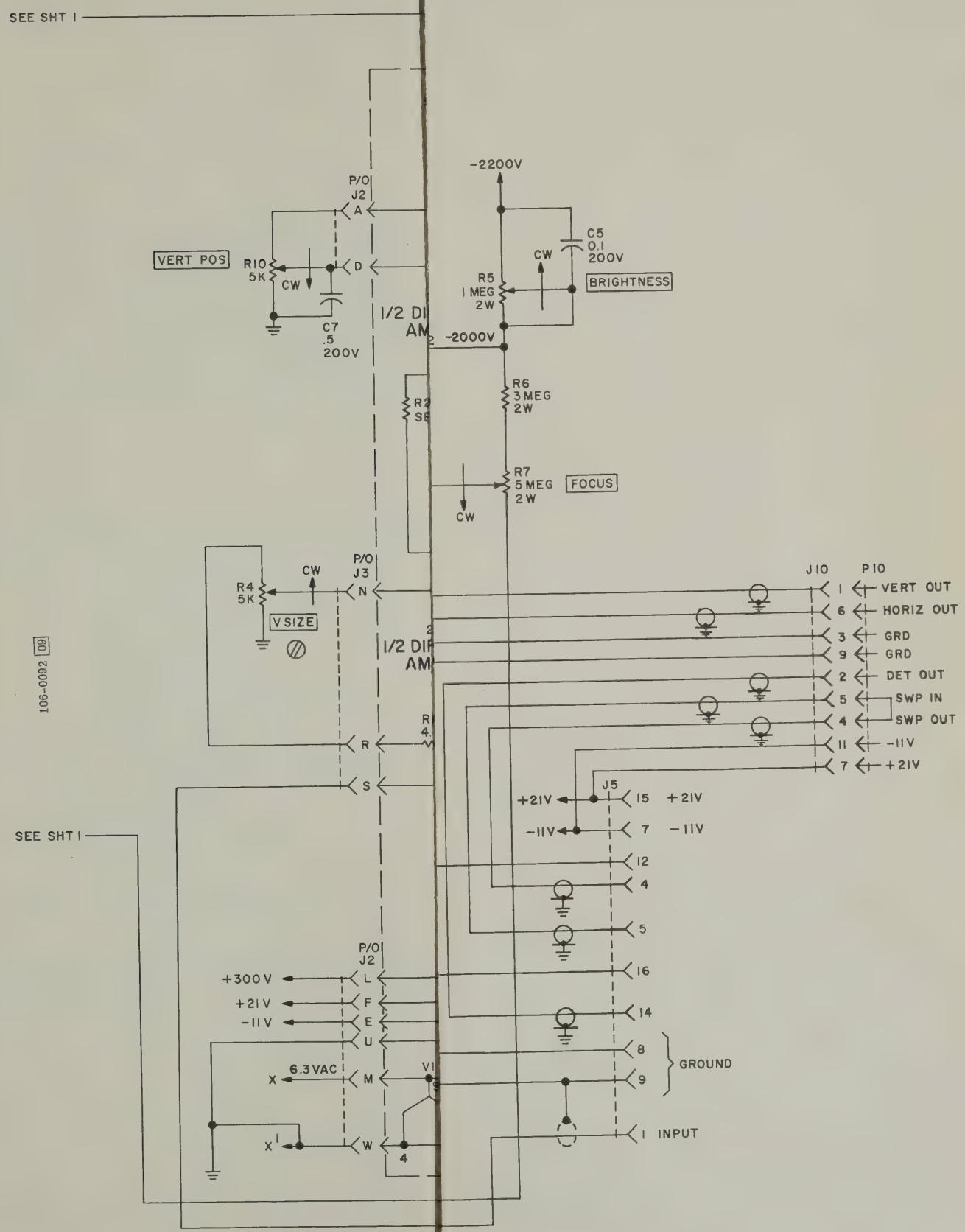


Figure 5-1. Schematic Diagram, Main Frame (Sheet 2 of 2)

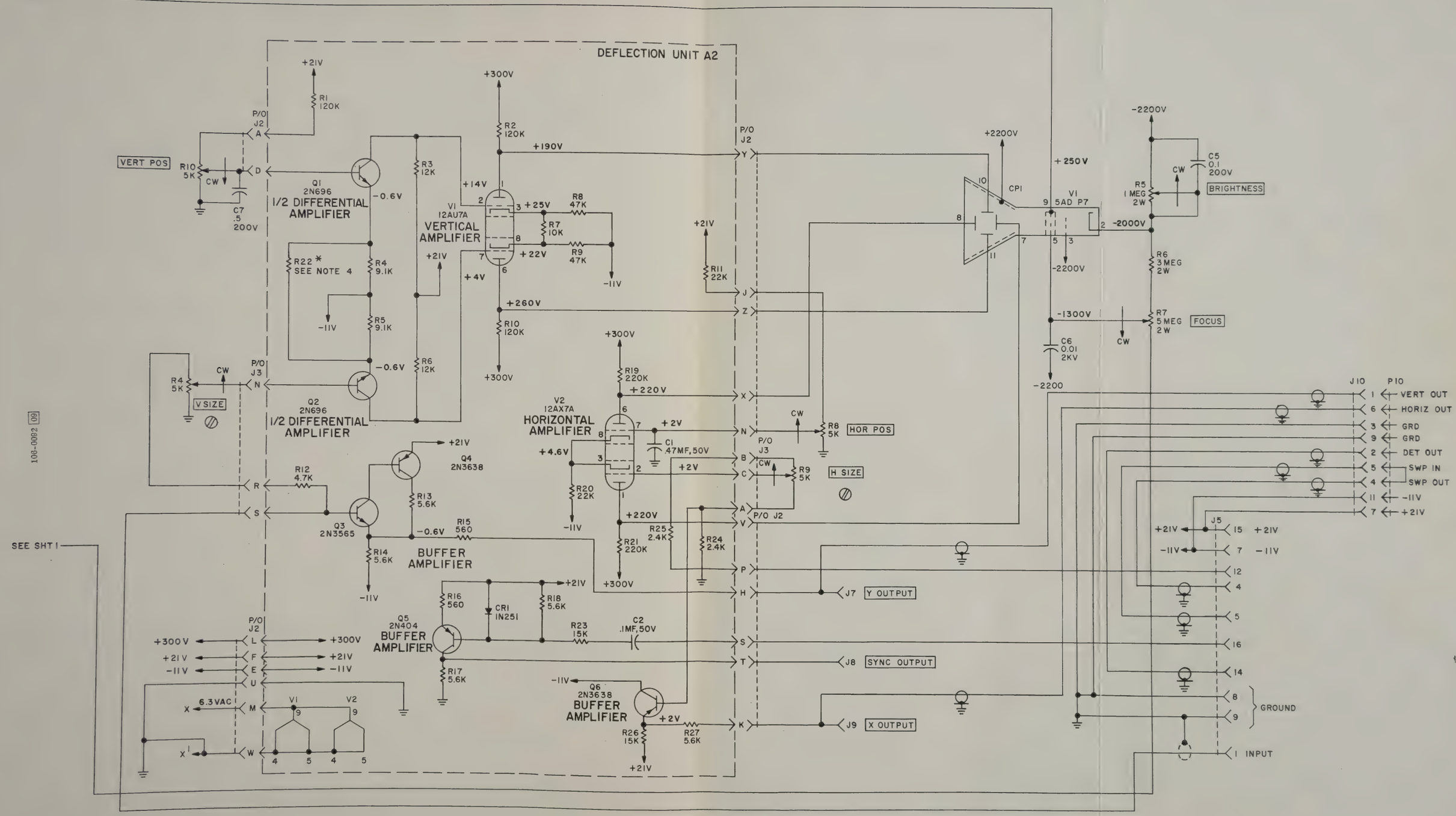


Figure 5-1. Schematic Diagram, Main Frame (Sheet 2 of 2)

SECTION VI
PARTS LIST

6-1. INTRODUCTION.

6-2. This parts list section includes all pertinent data necessary to locate, identify, and procure additional parts for the equipment. Parts are listed alpha-numerically by reference symbol and include all replaceable items such as electronic, electro-mechanical, and mechanical parts of the equipment. In some cases, values, ratings and manufacturer sources shown are nominal and variations may be found. Satisfactory replacement may be made with either the listed component or an exact replacement of the part(s) removed from the equipment.

6-3. ORDERING INFORMATION.

6-4. The following instructions will aid in ordering parts from the Parts Lists, table 6-2.

a. Address all inquiries or orders to:

CUSTOMER SERVICE
Department 500-1
The Singer Company
Metrics Division
915 Pembroke Street
Bridgeport, Connecticut, 06608

b. Include the following information:

1) Model and Serial Number of instrument.

2) Singer Part Number.

3) Reference Symbol Number.

4) Description (as shown on list).

6-5. HOW TO USE THE PARTS LIST.

6-6. Paragraphs 6-7 through 6-11 describe the use and meaning of the five columns included in the parts list (see figure 6-1).

6-7. REF SYMBOL COLUMN. The Ref Symbol Column (1, figure 6-1) contains an alpha-numerical listing of parts as they appear on equipment chassis, illustration, or schematic. The reference designation identifies the parts as to their component function in the instrument.

6-8. DESCRIPTION COLUMN. The Description Column (2, figure 6-1) contains the identification of component parts including all pertinent specifications. and Singer part number. When the description column is used for a part which is identical to a part which has already been described; SAME AS (3) is used along with the reference symbol of the previously used part. In these instances, columns 3, 4, 5 are left blank. When the description column is used for a reference symbol for which no part exists; NOT USED (4) is placed in the column. In these instances, columns 3, 4, 5, are left blank.

6-9. MANUFACTURER'S PART NUMBER COLUMN. The Manufacturer's Part Number column (5, figure 6-1) contains the part number as designated by the manufacturer of the part.

6-10. MFR'S CODE COLUMN. The Mfr's Code column (6, figure 6-1) references the manufacturer by an assigned code number as listed in Federal Supply Code Handbook H4-2. For manufacturers not listed in H4-2, a letter code will be assigned. Table 6-1 includes the manufacturer and his code designation.

6-11. MAINT QTY COLUMN. The Maint Qty column (7, figure 6-1) contains the number of additional components recommended to keep the equipment at an optimum performance level. The recommended number of components in the Maint Qty column is based on 2000 hours of equipment operation.

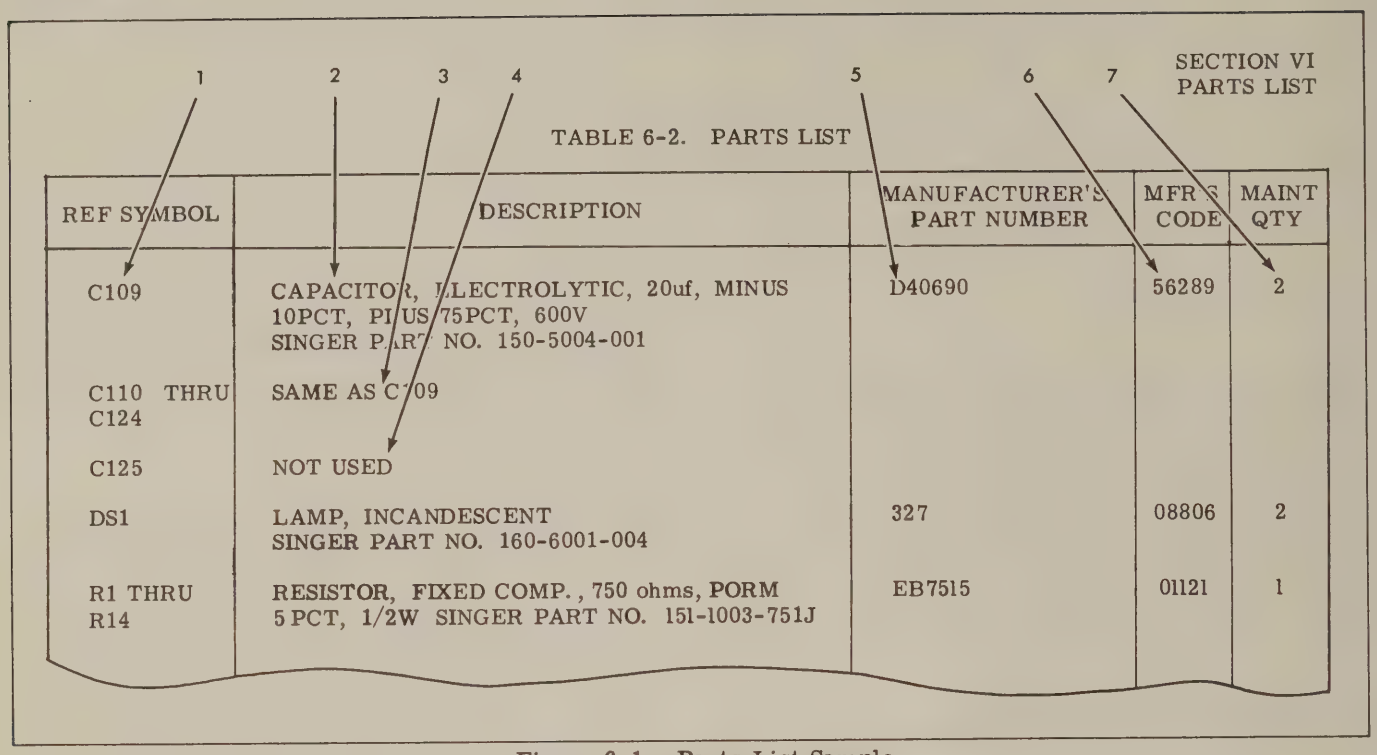


Figure 6-1. Parts List Sample

TABLE 6-1. MANUFACTURER'S CODE

Number	Name
01002	General Electric Co. Capacitor Department Hudson Falls, N.Y.
01121	Allen-Bradley Co., Milwaukee, Wis.
02777	Hopkins Engineering Co., San Fernando, Calif.
04713	Motorola Inc., Semiconductor Products Div., Phoenix, Ariz.
08806	Sloan Co., Sun Valley, Calif.
12987	Adelphi Electronics Mineola, N.Y.
16665	The Singer Co., Metrics Division Bridgeport, Conn.
19048	Amphenol Eastern Division of Amphenol-Borg Electrics Corp., Fairlawn, N.J.
19396	Illinois Tool Works Inc. Paktron Division Alexandria, Va.
53021	Sangamo Electric Co., Springfield, Ill.
56289	Sprague Electric Co., North Adams, Mass.
71279	Cambridge Thermionic Corp. Cambridge, Mass.
71400	Bussman Mfg., Division of McGraw Edison Co., St. Louis, Mo.
71450	CTC Corp. Elkhart, Ind.
71785	Cinch Mfg. Co. and Howard B. Jones Div., Chicago, Ill.
72619	Dialight Corp., Brooklyn, N.Y.
73386	Freed Transformer Co. Brooklyn, N.Y.
74545	Harvey Hubbel Inc., Bridgeport, Conn.
75915	Littelfuse Inc. Des Plaines, Ill.
81349	Military Specifications
83701	Electronic Devices, Inc., Yonkers, N.Y.
91418	Radio Materials Co. Chicago, Ill.
91802	Industrial Devices Inc. Edgewater, N.J.
99120	Plastic Capacitors Inc., Chicago, Ill.

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
CP1	CAP,ANODE/SINGER PART NO. 556023-079	118525	71785	1
CR1 AND CR2	RECTIFIER,DIODE/SINGER PART NO. 556118-029	10AG8	83701	1
CR3 AND CR4	SEMICONDUCTOR DEVICE,DIODE SINGER PART NO/556118-177	MR322R	04713	1
CR5 THRU CR8	SEMICONDUCTOR DEVICE,DIODE SINGER PART NO/556118-176	1N4002	81349	1
C1	CAPACITOR,ELECTROLYTIC,2 X 20 UF,450WVDC SINGER PART NO/556064-004	TVL-2755	56289	1
C2	CAPACITOR,ELECTROLYTIC,6500 UF,20WVDC SINGER PART NO/556166-029	539-2537-01	53021	1
C3	CAPACITOR,ELECTROLYTIC,2500 UF,15WVDC SINGER PART NO/556166-028	539-2532-01	53021	1
C4	CAPACITOR,ELECTROLYTIC,1400 UF,350WVDC SINGER PART NO/556074-183	539-2546-01	53021	1
C5	CAPACITOR,FIXED,METALLIZED,0.1 UF,PORM 20PCT 200 V /SINGER PART NO. 556120-120	P12D	02777	1
C6	CAPACITOR,CERAMIC,0.01 UF,2000 V SINGER PART NO. 556060-062	2-KV-0.01UF-HI-K	91418	1
C7	CAPACITOR,FIXED,METALLIZED,0.5 UF,PORM 20PCT 200 V /SINGER PART NO. 556120-128	P52DS	02777	1
DS1	LAMP,PILOT SINGER PART NO. 160-6006-004	2110-A4	91802	3
DS2 THRU DS5	LAMP,INCANDESCENT SINGER PART NO/160-6001-002	349	08806	4
F1	FUSE,DELAY, 3/4 AMP SINGER PART NO. 556146-897	313.750	75915	5
F2	FUSE,CARTRIDGE, 3 AMP SINGER PART NO. 556006-012	AGC3A	71400	5
J1 AND J2	CONNECTOR / SINGER PART NO. 556166-125	143-022-01	19048	1
J3	CONNECTOR,PRINTED CIRCUIT,IS CONTACTS SINGER PART NO/556166-043	143-015-01	19048	1
J4	CONNECTOR,PRINTED CIRCUIT	149-0035-001	16665	1
J5	CONNECTOR,FEMALE /SINGER PART NO. 556166-046	26-190-16	19048	1
J6	CONNECTOR,RECEPTACLE,ELECTRICAL,3 WIRE AC POWER,MALE,TWIST-LOCK SINGER PART NO/556010-003	7486	74545	1
J7 THRU J9	CONNECTOR,COAXIAL SINGER PART NO/168-4006-001	UG-1094/U	81349	1
J10	SOCKET,11 PIN SINGER PART NO. 556146-703	78-S11	19048	1
P10	PLUG,11 PIN, OCTAL TYPE SINGER PART NO. 556016-165	86-CP11T	19048	1
Q1 THRU Q3	TRANSISTOR/SINGER PART NO. 556166-026	2N2152A	81349	1

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
Q4 AND Q5	TRANSISTOR SINGER PART NO. 556146-249	2N1971	81349	1
R1	RESISTOR,COMPOSITION,100K,PORM 5 PCT,1/2W SINGER PART NO/151-1003-104J	EB1045	01121	1
R2	RESISTOR,COMPOSITION,680 OHMS,PORM 5 PCT, 1/2 W SINGER PART NO/151-1003-681J	EB6815	01121	1
R3	RESISTOR,VARIABLE,60HMS WITH SWITCH S1	556056-001	16665	1
R4	RESISTOR,VARIABLE,COMPOSITION,5K,1/2W	151-0001-029	16665	1
R5	RESISTOR,VARIABLE,1 MEGOHM	556146-221	16665	1
R6	RESISTOR,COMPOSITION,3MEG,PORM 5 PCT,2W SINGER PART NO/151-1005-305J	HB3055	01121	1
R7	RESISTOR,VARIABLE,5 MEGOHMS	556146-222	16665	1
R8 THRU R10	SAME AS R4			
R11	RESISTOR,COMPOSITION,270K OHMS,PORM 5 PCT 1/2W / SINGER PART NO 151-1003-274J	EB2745	01121	1
S1	NON REPLACEABLE PART OF R3			
S2	SWITCH	133-0015-001	16665	1
T1	TRANSFORMER,POWER/SINGER PART NO. 556020-218	36851	73386	1
T2	TRANSFORMER,POWER/SINGER PART NO. 556020-219	36898	73386	1
V1	ELECTRON,TUBE/SINGER PART NO. 556027-037	5ADP7	81349	1
XDS1	SOCKET,LAMP/SINGER PART NO. 556002-418	515-0050	72619	1
XDS2 THRU XDS5	SOCKET,LAMP,GRATICULE SINGER PART NO/556002-129	162-8430-09-602	72619	1
XF1 AND XF2	FUSEHOLDER/SINGER PART NO. 556006-015	342004	75915	1
XV1	SOCKET,CRT/SINGER PART NO. 556024-047	3B14	71785	1
A1	REGULATOR ASSEMBLY	103-0400-001	16665	1
A1C1 AND A1C2	CAPACITOR,FIXED,0.056 UF,PORM 10 PCT,50V SINGER PART NO/556120-190	MW-600	19396	1
A1C3 AND A1C4	CAPACITOR,FIXED,0.047 UF,PORM 10 PCT, 50V SINGER PART NO/556120-191	MW-600	19396	1
A1C5	CAPACITOR,ELECTROLYTIC,250 UF,12WVDC SINGER PART NO/556166-113	TE-1138	56289	1
A1C6	NOT USED			
A1C7	CAPACITOR,ELECTROLYTIC,50 UF,50WVDC SINGER PART NO/556166-116	TE-1307	56289	1
A1C8	CAPACITOR,ELECTROLYTIC,100 UF,25WVDC SINGER PART NO/556166-110	TE-1211	56289	1
A1C9 AND A1C10	CAPACITOR,ELECTROLYTIC,200 UF,15WVDC SINGER PART NO/556166-115	TE-1164	56289	1

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A1C11	SAME AS A1C5			
A1CR1 AND A1CR2	SEMICONDUCTOR DEVICE,DIODE SINGER PART NO/556118-045	1N128	81349	1
A1CR3	SEMICONDUCTOR DEVICE,DIODE SINGER PART NO/556166-039	1N823A	81349	1
A1CR4	SEMICONDUCTOR DEVICE,DIODE SINGER PART NO/556166-037	1N969B	81349	1
A1CR5	SAME AS A1CR3			
A1Q1 THRU A1Q4	TRANSISTOR/SINGER PART NO. 556166-087	2N2270	81349	1
A1Q5	TRANSISTOR FACTORY SELECTED			
A1Q7	SAME AS A1Q5			
A1Q9 AND A1Q10	SAME AS A1Q1			
A1R1	RESISTOR,COMPOSITION,15K,PORM 5 PCT,1/2W SINGER PART NO/151-1003-153J	EB1535	01121	2
A1R2	RESISTOR,COMPOSITION,300 OHMS,PORM 5 PCT, 1/2W SINGER PART NO/151-1003-301J	EB3015	01121	1
A1R3	RESISTOR,COMPOSITION,5.1K,PORM 5 PCT,1/2W SINGER PART NO/151-1003-512J	EB5125	01121	1
A1R4	RESISTOR,COMPOSITION,39 OHMS,PORM 5 PCT,1/2W SINGER PART NO/151-1003-390J	EB3905	01121	1
A1R5	SAME AS A1R3			
A1R6	SAME AS A1R4			
A1R7	SAME AS A1R2			
A1R8	SAME AS A1R1			
A1R9	RESISTOR,COMPOSITION,100 OHMS,PORM 5 PCT, 1/2W SINGER PART NO/151-1003-101J	EB1015	01121	1
A1R10	RESISTOR,COMPOSITION,560 OHMS,PORM 5 PCT 1/2W SINGER PART NO/151-1003-561J	EB5615	01121	1
A1R11 AND A1R12	RESISTOR,COMPOSITION,1K,PORM 5 PCT,1/2W SINGER PART NO/151-1003-102J	EB1025	01121	1
A1R13	RESISTOR,VARIABLE,1K PORM 30 PCT,1/8W SINGER PART NO/556056-121	U201R102B	71279	1
A1R14	RESISTOR,COMPOSITION 1.2K,PORM 5 PCT,1/2W SINGER PART NO/151-1003-122J	EB1225	01121	1
A1R15	RESISTOR,COMPOSITION,2.2K,PORM 5 PCT,1/2W SINGER PART NO/151-1003-222J	EB2215	01121	1
A1R16	SAME AS A1R10			
A1R17	RESISTOR,COMPOSITION,220 OHMS,PORM 5 PCT, 1/2W / SINGER PART NO. 151-1003-221J	EB221J	01121	1

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A1R18	SAME AS A1R10			
A1R19	SAME AS A1R9			
A1R20 AND A1R21	SAME AS A1R11			
A1R22	SAME AS A1R13			
A1R23	SAME AS A1R14			
A1R24	RESISTOR,COMPOSITION,1.8K,PORM 10 PCT,1/2W SINGER PART NO/151-1003-182K	EB1821	01121	1
A1R25	RESISTOR,VARIABLE,500K,PORM 30 PCT,1/8W SINGER PART NO/556056-123	U201R504B	71450	1
A1R26	RESISTOR,COMPOSITION,150K OHMS,PORM 5 PCT 1/2W /SINGER PART NO/151-1003-154J	EB1545	01121	1
A1R27 AND A1R28	RESISTOR,COMPOSITION,22 OHMS,PORM 5 PCT,1/2W SINGER PART NO/151-1003-220J	EB2205	01121	1
A2	DEFLECTION ASSEMBLY	103-0401-001	16665	1
A2CR1	SEMICONDUCTOR DEVICE,DIODE SINGER PART NO/556118-046	1N251	81349	1
A2C1	CAPACITOR,FIXED,0.47 UF,PORM 20 PCT,50V SINGER PART NO/556146-273	GE6517AB-474	01002	1
A2C2	CAPACITOR,FIXED,MYLAR,0.10 UF,PORM 10PCT,50V SINGER PART NO. 150-4002-J104K	601-PE TYPE	84411	1
A2Q1 AND A2Q2	TRANSISTOR/SINGER PART NO. 556017-064	2N696	81349	1
A2Q3	TRANSISTOR/SINGER PART NO. 556146-254	2N3565	81349	1
A2Q4	TRANSISTOR/SINGER PART NO. 556146-255	2N3638	81349	1
A2Q5	SAME AS A1Q1			
A2Q6	SAME AS A2Q4			
A2R1 AND A2R2	RESISTOR,COMPOSITION,120K,PORM 5 PCT,1/2W SINGER PART NO/151-1003-124J	EB1245	01121	1
A2R3	RESISTOR,COMPOSITION,12K,PORM 5 PCT,1/2W SINGER PART NO/151-1003-123J	EB1235	01121	1
A2R4 AND A2R5	RESISTOR,COMPOSITION,9.1K,PORM 5 PCT,1/2W SINGER PART NO/151-1003-912J	EB9125	01121	1
A2R6	SAME AS A2R3			
A2R7	RESISTOR,COMPOSITION,10K,PORM 5 PCT,1/2W SINGER PART NO/151-1003-103J	EB1035	01121	1
A2R8 AND A2R9	RESISTOR,COMPOSITION,47K,PORM 5 PCT,1/2W SINGER PART NO/151-1003-473J	EB4735	01121	1
A2R10	SAME AS A2R1			
A2R11	RESISTOR,COMPOSITION,22K,PORM 5 PCT,1/2W SINGER PART NO/151-1003-223J	EB2235	01121	1

TABLE 6-2. PARTS LIST

Ref Symbol		Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A2R12		RESISTOR,COMPOSITION,4.7K,PORM 5 PCT,1/2W SINGER PART NO/151-1003-472J	EB4725	01121	1
A2R13 A2R14	AND	RESISTOR,COMPOSITION,5.6K,PORM 5 PCT,1/2W SINGER PART NO/151-1003-562J	EB5625	01121	1
A2R15 A2R16	AND	SAME AS A1R10			
A2R17 A2R18	AND	SAME AS A2R13			
A2R19		RESISTOR,COMPOSITION,220K,PORM 5 PCT,1/2W SINGER PART NO/151-1003-224J	EB2245	01121	1
A2R20		SAME AS A2R11			
A2R21		SAME AS A2R19			
A2R22		SAME AS A1R9 FACTORY SELECTED			
A2R23		SAME AS A1R1			
A2R24 A2R25	AND	RESISTOR,COMPOSITION,2.4K OHMS,PORM 5 PCT 1/2W /SINGER PART NO. 151-1003-242J	EB2425	01121	1
A2R26		SAME AS A1R1			
A2R27		SAME AS A2R13			
A2V1		ELECTRON TUBE/SINGER PART NO/556027-171	12AU7A	81349	1
A2V2		ELECTRON TUBE/SINGER PART NO/556027-022	12AX7A	81349	1
A2XV1 A2XV2	AND	SOCKET,ELECTRON TUBE SINGER PART NO/556024-339	9BC-B1	71785	1
A3		HIGH VOLTAGE ASSEMBLY	103-0402-001	16665	1
A3CR1 A3CR4	THRU	SEMICONDUCTOR DEVICE,DIODE,SILICON SINGER PART NO/556118-179	426-EH300	83701	1
A3C1 A3C4	THRU	CAPACITOR,FIXED,MYLAR,0.03 UF, 4000 WVDC SINGER PART NO. 556146-609	LR-40	99120	1
A3R1 A3R2	AND	RESISTOR,COMPOSITION,10 MEG-OHM,PORM 10 PCT, 2W SINGER PART NO/151-1005-106K	HB1061	01121	1
A3R3 A3R4	AND	RESISTOR,COMPOSITION,4.7 MEG-OHM,PORM 10 PCT 2W SINGER PART NO/151-1005-475K	HB4751	01121	1

INSTRUCTION MANUAL

Panoramic*

PANALYZOR MODULE

MODEL CA-5

Serial No. _____

Instruction Manual No. 110-5046

SINGER
INSTRUMENTATION

Precision electrical and electronic instruments for measurement

emc — EMPIRE* — Gertsch* — Panoramic* — Sensitive Research*

THE SINGER COMPANY • METRICS DIVISION

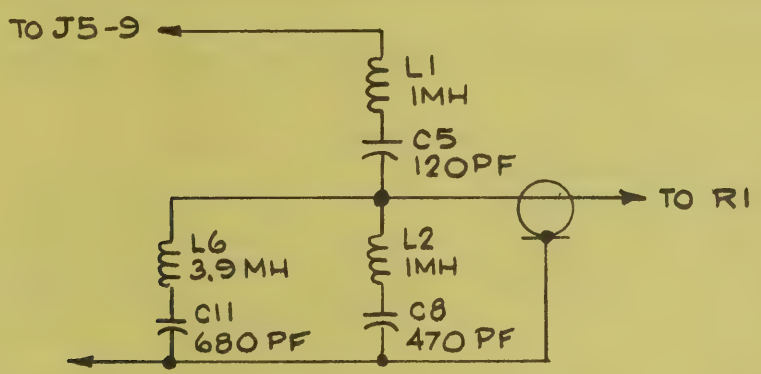
*A Trademark of THE SINGER COMPANY

ADDENDUM

for

PANALYZOR MODEL CA-5

1. a. In figure 5-1, add L6 and C11 and modity the existing schematic as illustrated below.



1. b. Add the following entries into table 6-2.

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
C11	CAPACITOR, FIXED, DIPPED MICA 680 PF, PORM 5 PCT, 300 V Singer Part No. 150-2002-681EJO	DM15E681J0 300WV4CR	7 2136	1
L6	COIL, RF, 3.9 MH Singer Part No. 556012-215	393AF	76493	1

2. a. In figure 5-4, shunt a capacitor (C28, 0.01) across R37.

2. b. In table 6-2, add

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A8C28	SAME AS A3C2			

ADDENDUM

for

MODEL CA-5

1. In figure 5-7, change A2CR3 diode type entry from ZD2.4B to 1N4370A.

2. In table 1-2, change A2CR3 diode type entry from ZD2.4B to 1N4370A.

3. Make the following changes to the List of Replaceable Parts.

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A2CR3	SEMICONDUCTOR DEVICE, DIODE Singer P/N 556146-881	1N4370A	81349	1
A6CR3	SEMICONDUCTOR DEVICE, DIODE Singer P/N 556146-729	ZD4.7B	12060	1

Addendum No. 498
(01 to 02)

ADDENDUM

for

MODEL CA-5 and CA-5/GD

1. On figure 5-3, add reference symbol T2 to the unmarked transformer.

2. On figure 5-4, make the following changes:

   a. Change capacitor A8C5 from "10UF" to "10PF"
   b. Change capacitor A8C15 from "5UF" to "5PF"

3. On figure 5-5, make the following changes:

   a. Add resistor A7R8, 3K between the junction of R7 and R9.
   b. Add resistor A7R70, 10K between the junction of C39 and R57.

4. On figure 5-8, make the following changes:

   a. Add capacitor A4C7 between the collector of Q3 and the emitter of Q3.
   b. Add capacitor A4R5 between the junction of Y1 and L1.

5. Make the following changes to the List of Replaceable Parts.

   a. Delete R14 from the Parts List.
   b. Add the items noted below to the Parts List.

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
C1	CAPACITOR, FIXED, ELECTROLYTIC, 30UF, PLUS 75, MINUS 10 PCT, 15V SINGER PART NO. 556074-025	30D306G015 CBO	56289	1
C2	CAPACITOR, FIXED, METALLIZED PAPER, 2UF, PORM 5 PCT, 50V SINGER PART NO. 556146-719	2PP5D	02777	1
C7	CAPACITOR, FIXED, ELECTROLYTIC, 5UF, PLUS 150, MINUS 10 PCT, 50V SINGER PART NO. 556074-169	CE11C050G	56289	1
R8	RESISTOR, FIXED, FILM 2945 OHMS, PORM 1 PCT, 1/4W SINGER PART NO. 556146-647	TYPE RN60C	81349	1

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
R9	RESISTOR, FIXED, FILM, 5975 OHMS, PORM 1 PCT, 1/4W SINGER PART NO. 556146-647	TYPE RN60C	81349	1
A1R6	RESISTOR, VARIABLE, 50K OHMS, PORM 30 PCT, 1/4W SINGER PART NO. 556146-633	U201R503B	71450	1
A1R7 THRU R1R11	RESISTOR, VARIABLE, 100K OHMS, PORM 30 PCT, 1/4W SINGER PART NO. 556146-632	U201R104B	71450	1
A2C8	CAPACITOR, FIXED, METALLIZED PAPER, 0.5UF, PORM 20 PCT, SINGER PART NO. 556146-720	P5P5D	02777	1
A2R6	RESISTOR, FIXED, COMP., 1.3K OHMS, PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-123J	CB1325	01121	1
A2R20	RESISTOR, FIXED, PREC., 200 OHMS, PORM 1 PCT, 1/2W SINGER PART NO. 151-1008-B2000F	C1/2E200 OHMS PORM 1 PCT	12126	1
A4C9 AND A4C10	CAPACITOR, FIXED, ELECTROLYTIC, 5UF, PLUS 75, MINUS 10 PCT, 25V SINGER PART NO. 556166-119	TE1202	56289	1
A5C6	CAPACITOR, FIXED, ELECTROLYTIC, 50UF, PLUS 50, MINUS 10 PCT, 25V SINGER PART NO. 556075-009	40D184A2	56289	1
A6C3	CAPACITOR, FIXED, METALLIZED, PAPER, 0.22UF, PORM 20 PCT, 50V SINGER PART NO. 556146-641	P22P5D	02777	1
A6C8	CAPACITOR, FIXED, DIPPED MICA, 3000PF, PORM 5 PCT, 100V SINGER PART NO. 150-2002-302FJO	DM15F302JO 100WV4CR	72136	1
A6C9	CAPACITOR, FIXED, DIPPED MICA, 3900PF, PORM 5 PCT, 100V SINGER PART NO. 150-2002-392FJO	DM15F392JO 100WV4CR	72136	1
A6C18	CAPACITOR, FIXED, TANTALUM, 1.5UF, PORM 10 PCT, 20V SINGER PART NO. 556146-643	SCM155FPO 2A2	01295	1

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A6C19	CAPACITOR, FIXED, TANTALUM, 22UF, PORM 10 PCT, 35V SINGER PART NO. 556146-644	SCM226GPO 35C2	01295	1
A6Q6	TRANSISTOR SINGER PART NO. 556146-652	2N1671B	81349	1
A6R21	RESISTOR, FIXED, COMP., 4.7K OHMS, PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-472J	CB4725	01121	1
A7C10	CAPACITOR, FIXED, ELECTROLYTIC, 50UF, PLUS 50, MINUS 10 PCT, 50V SINGER PART NO. 556073-004	TE1307	56289	1
A7R64	RESISTOR, FIXED, COMP., 120K OHMS, PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-124J	CB1245	01121	1
A8C28	SAME AS A3C2			
A8R15	SAME AS A6R10			
A9C1	CAPACITOR, FIXED, CERAMIC, 0.047UF, PORM 20 PCT, 50V SINGER PART NO. 556146-728	65F12AB473	01002	1
A9R2	RESISTOR, FIXED, COMP., 22 OHMS, PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-220J	CB2205	01121	1

ADDENDUM

for

MODEL CA-5

I. PURPOSE.

To correct existing errors in handbook.

II. ADDENDUM.

a. Change step 2c (procedure) of table 4-3 (page 4-8) to read:

> "c. Connect the frequency counter input to the X OUT connector on the rear of the MF-5. Set the FREQ SCALE-Hz/DIV switch to VAR and rotate the FREQ SCALE control fully CW. Record the frequency counter indication."

b. Change step 2c (acceptable indication) of table 4-3 (page4-8) to read:

> "c. Frequency counter reads 30 Hz minimum."

c. Page 4-20, paragraph 4-27n, change 250 kHz to 250 Hz.

d. Page 4-21, paragraph 4-27q, change A6R2 to read A6R3.

Addendum No. 519

ADDENDUM

for

MODEL CA-5
(Effective Serial No. U17258 and above)

Make the following changes to the List of Replaceable Parts.

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A8C29	CAPACITOR, FIXED, CERAMIC DICS, 0.05 uf, PLUS 80 PCT, MINUS 20 PCT, 200 V Singer Part No. 556074-057	33C137	56289	1
A10C1	SAME AS A8C29			

Addendum No. 522

ADDENDUM

for

MODEL CA-5

(Effective Serial No. U15760 and above)

1. In figure 5-2, change A10C3, 240PF to 200 PF.

2. In figure 5-5, add R8 3K to the unmarked resistor in the emitter circuit of Q2.

3. In figure 5-5, change R29, 200 in the collector circuit of Q6 to R27, 200.

4. Make the following changes to the List of Replaceable Parts.

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A10C3	SAME AS A3C6			

Addendum No. 526
(05 to 06)

ADDENDUM

for

PANALYZOR, MODEL CA-5

(Effective on Serial Numbers U18002, U18016, U18028, U18029, U18031 thru U18033, U18035, thru U18039, U18041, U18042 and Above)

I. PURPOSE.

To provide the A2 plug-in printed-circuit board with a better ground connection, by electrically connecting the A2 to the A3 and A4 boards.

II. ADDENDUM.

There are two clips that straddle printed-circuit boards A2, A3, and A4. These clips are hinged on printed-circuit board A4, and the other end of each clip snaps in place along the top horizontal edge of printed-circuit board A2. For proper operation, these clips should be in place at all times.

ADDENDUM

for

PANALYZORS
MODELS CA-5, CA-5-1 and CA-5/GD

I. PURPOSE.

To correct the existing errors in this manual.

II. ADDENDUM.

a. Change the procedure in step 2c of table 4-3 as follows:

> "2c. Connect the frequency counter input to the X OUT connector on the rear of the Model MF-5 Main Frame. Set the FREQ SCALE-Hz/DIV switch on the Panalyzor to the VAR position and rotate the FREQ SCALE control fully CW. Record the frequency counter indication."

b. Change step 2c under the Acceptable Indication column of table 4-3 as follows:

> "2c. Frequency counter reads 30 Hz minimum."

c. In paragraph 4-27n, change "250 kHz" to read "250 Hz".

d. In paragraph 4-27q, change "A6R2" to read "A6R3".

3. In figure 3-2, remove duplicate control marked "R14 GAIN" connected to the top side of box labelled "EMITTER FOLLOWER Q4" of the 500 kHz IF AMPLIFIER A5. Add the word "GAIN" to control labelled R14 adjacent to the bottom of the same box labelled "EMITTER FOLLOWER Q4".

Addendum No. 553

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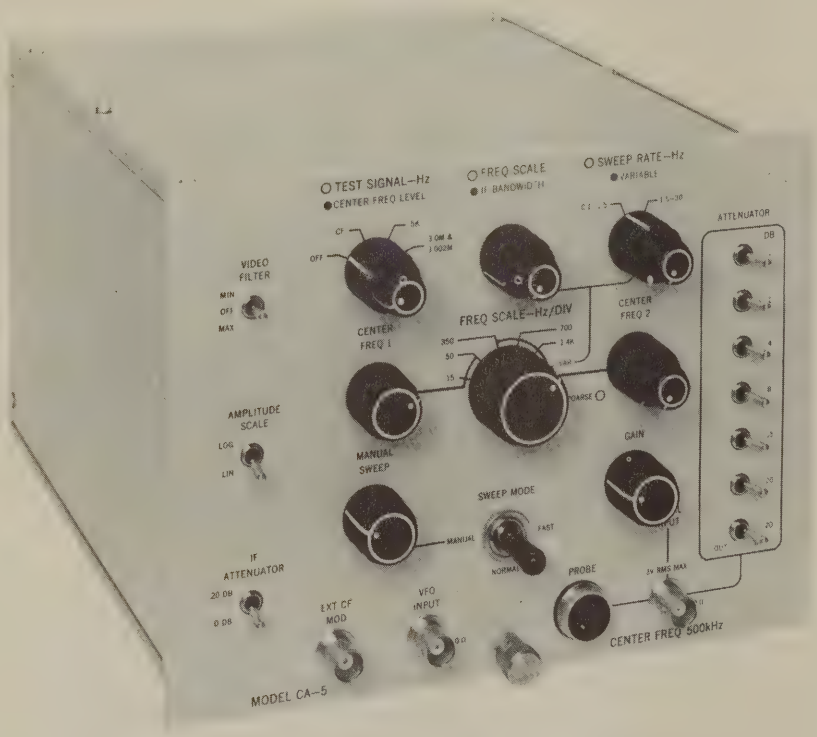

Figure 1-1. Model CA-5 Panalyzor

SECTION I
INTRODUCTION

1-1. SCOPE OF MANUAL.

1-2. This instruction manual provides operating and maintenance instructions for the PANORAMIC* Panalyzor, Model CA-5 (hereafter referred to as the Panalyzor) manufactured by The Singer Company, Metrics Division. Included in this manual are a general description of the Panalyzor, installation and operating instruction, theory of operation, maintenance information and data, schematic diagrams and a repair parts list. The Panalyzor is illustrated in figure 1-1.

1-3. The information contained in this manual refers to the standard version of the Panalyzor and is current only to the date of publication. Differences in equipment components, specifications, and performance resulting from The Singer Company's continuous production improvement program or individual customer design and application requirements are described in addendum sheets.

1-4. PURPOSE AND USE OF EQUIPMENT.

1-5. The Panalyzor is a plug-in unit designed to analyze and monitor complex and/or random signals when used in the PANORAMIC Model SSB-50 Single Sideband Analyzer System. Some typical applications of the Panalyzor are listed below:

a. Single sideband studies.

b. Hum sideband studies (e.g., ±60- or ±50-Hz component readily analyzed down to -60 dB).

c. R-f cross modulation analysis.

d. Adjacent channel interference investigation.

e. Band occupancy studies.

f. Residual carrier and sideband level measurements.

g. Spurious oscillation or modulation detection.

h. F-m deviation measurements.

1-6. Inquiries are invited regarding special applications of the Panalyzor to particular requirements. Such inquiries should be directed to the attention of the Applications Engineering Department.

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1-7. GENERAL DESCRIPTION.

1-8. The Panalyzor is a completely solid-state narrow-band swept analyzer module with an input center frequency of 500 kHz. It operates in conjunction with the Model RF-8 Tuning Head and Model REC-2 Range Extending Converter in the SSB-50 Single Sideband Analyzer System to analyze signals in the 10 Hz to 40 MHz frequency range. The Panalyzor also generates the sawtooth waveform for the horizontal sweep deflection amplifiers in its associated main frame.

1-9. The module has five preset sweep ranges that can be selected by means of a FREQ SCALE-Hz/DIV switch: 150 Hz, 500 Hz, 3.5 kHz, 7 kHz, and 14 kHz; a 0-100 kHz variable sweep mode can also be selected by this control. In the preset positions of the FREQ SCALE-Hz/DIV switch, the resolution and sweep rate is automatically optimized. Continuous i-f bandwidth (resolution) control from 10 Hz to approximately 2 kHz is obtainable on the variable position of the control. An additional manual sweep mode enables an operator to position the CRT dot to any point of interest.

1-10. Tuning the Panalyzor to an input center frequency of 500 kHz is accomplished by the CENTER FREQ 1 control for the two lower preset sweep ranges (150 and 500 Hz) and the CENTER FREQ 2 COARSE and FINE controls for the remaining three presets sweep ranges and variable sweep range. For the variable sweep range, the FREQ SCALE control varies the sweep width from 0 to 100 kHz, and the SWEEP RATE control varies the sweep rate from 0.1 to 30 Hz.

1-11. Internal test signals are also provided within the Panalyzor to locate its center frequency; to set up the sweep width when operating in the variable sweep mode; and to check the odd-order distortion of the Panalyzor. The front-panel TEST SIGNAL-Hz control permits the selection of any or none of these test signals.

1-12. The Panalyzor provides either a linearly or logarithmically scaled d-c output. Signal sensitivity is less than 20 microvolts for full-scale linear output and less than 200 microvolts for the logarithmic output. Calibrated r-f (ATTENUATOR switches) and i-f (IF ATTENUATOR switch) attenuators for adjusting the deflection produced by strong signals are provided; an uncalibrated continuously variable GAIN control is also provided. Residual unwanted

in-band responses, including those due to hum and intermodulation distortion, are suppressed at least 60 dB.

1-13. The Panalyzor occupies a half-rack width in such units as the Model MF-5 Main Frame. Components are mounted on the rear of the front panel and on nine printed-circuit boards. Operating power for the Panalyzor is provided by the main frame in which it is installed, thereby eliminating the need for an integral power supply.

1-14. SPECIFICATIONS.

1-15. Table 1-1 lists the electrical and physical characteristics of the Panalyzor.

1-16. TRANSISTOR, DIODE AND CRYSTAL COMPLEMENT.

1-17. The transistor, diode and crystal complement of the Panalyzor is given in table 1-2.

TABLE 1-1. SPECIFICATIONS

Input center frequency:	500 kHz.
Bandpass region (after first mixer):	450 to 550 kHz.
Sweep width:	Preset: 150 Hz, 500 Hz, 3.5 kHz, 7 kHz, and 14 kHz with automatic optimum resolution. Variable: 0 to 100 kHz, continuously adjustable.
Sweep rate:	0.1 Hz for 150- and 500-Hz preset sweep widths (may be increased to 1-Hz with front panel control); 1 Hz for 3.5-, 7-, and 14-kHz preset sweep widths; 0.1 to 30 Hz for 0 to 100 kHz variable sweep width; or manually controlled.
I-f bandwidth (Resolution):	10 Hz to 2 kHz at -6 dB points. Automatically optimized for 5 preset sweep width ranges with 50-Hz skirt selectivity at -60 dB point on 150-Hz preset scan. (Resolution is the frequency separation of two signals of equal amplitude, the deflections of which intersect 3 dB down from their amplitude peaks. Figure 1-2 is a resolution graph for a CRT linear horizontal scan. Figure 1-3 presents the minimum frequency separation required to measure signals of unequal amplitude. These graphs show typical curves.)
Amplitude scale:	Linear: Calibrated 1 to 10 in 10 percent increments, accuracy ±3%. Log: Calibrated 0 to -40 dB in 5 dB increments, accuracy ±1 dB from 0 to -30 dB, ±2 dB from -30 dB to -40 dB; extendable to -60 dB.
Sensitivity full scale:	Linear deflection: 20 microvolts minimum. Logarithmic deflection: 200 microvolts minimum.
Minimum detectable signal:	2 microvolts.
Response flatness:	Overall: Better than ±2 dB, 2 MHz - 40 MHz. In-band: Better than ±0.5 dB.
Dynamic range:	All in-band (odd-order) intermodulation products at least 60 dB down.
Image rejection:	Better than 40 dB for 500-kHz i-f

(Cont'd)

TABLE 1-1. SPECIFICATIONS (Cont'd)

Attenuators:	Input: 0 to 70 dB, in 1 dB steps; accuracy, 0.05 dB/dB, cumulative. I-f: 20 dB (±1/2 dB).
Input impedance:	50 ohms direct or 10 megohms with optionally available PRB-50 Probe (panel jack available for powering the PRB-50).
Self-test features:	
Calibrating oscillator:	500-kHz crystal-controlled oscillator for checking center frequency. Amplitude is continuously adjustable.
Internal marker:	5-kHz oscillator modulates 500-kHz crystal-controlled oscillator to provide 5-kHz markers for sweep width calibration to 100 kHz.
Two-tone test:	Two crystal-controlled r-f tones (3 MHz and 3.002 MHz).
Operating temperature range:	0 to 55 degrees centigrade.
Physical characteristics:	
Height:	6-1/8 inches
Width:	8-1/4 inches
Depth (behind panel):	10-1/4 inches
Weight:	9 pounds

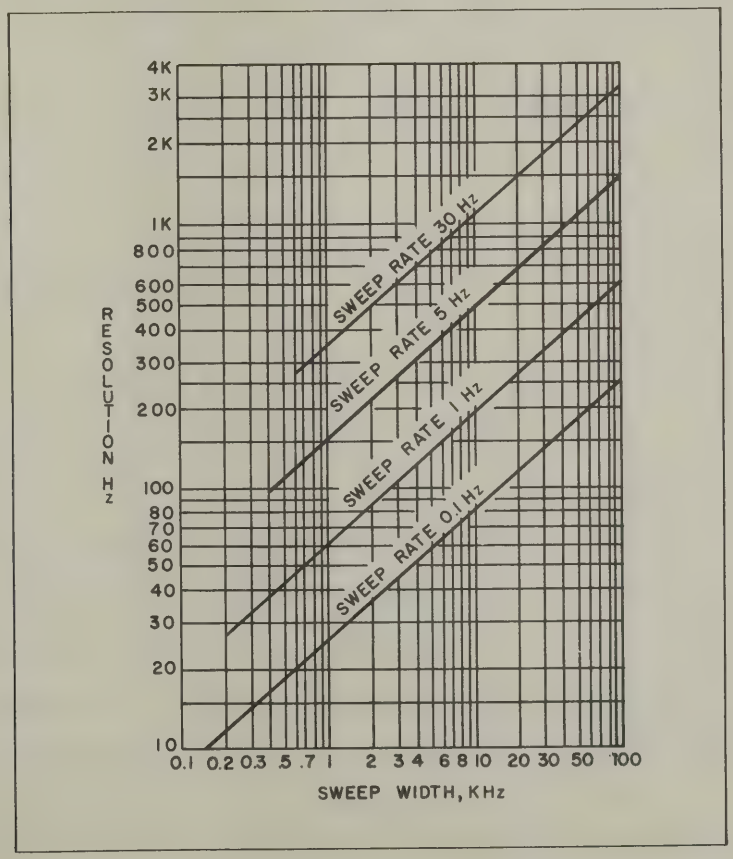


Figure 1-2. Typical Resolution Versus Sweep Width

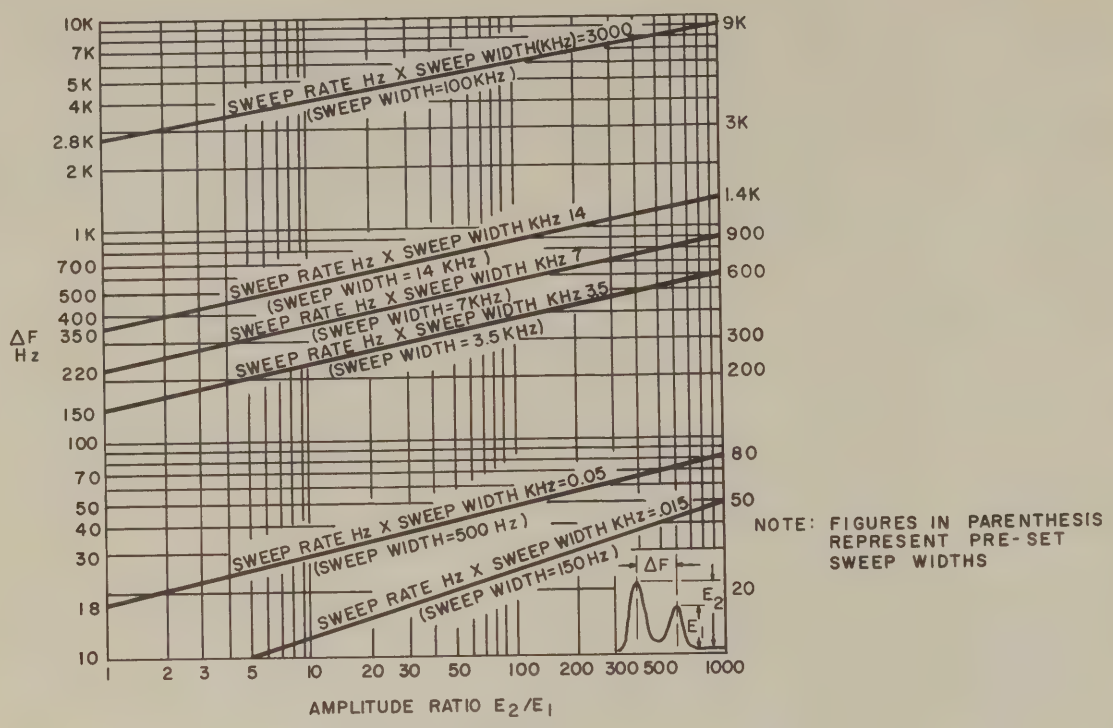


Figure 1-3. Typical Minimum Frequency Separation Required to Measure Amplitude Ratios (Skirt Selectivity)

TABLE 1-2. TRANSISTOR, DIODE, AND CRYSTAL COMPLEMENT

Reference Designation Symbol	Type	Function
	Transistors	
A2Q1, A2Q2	2N3563	Multivibrator
A2Q3, A2Q5, A2Q6	2N3638	Unity-gain Amplifier
A2Q4	2N3642	Unity-gain Amplifier
A2Q7	2N3638	Emitter Follower
A2Q8	2N3642	Emitter Follower
A3Q1, A3Q2	2N3638	Push-Pull Emitter Follower
A3Q3	2N3638A	3-MHz Osc.
A3Q4	2N3638A	3.002-MHz Osc.
A4Q1, A4Q2	2N3638	Dual Amplifier
A4Q3	2N3638A	500-kHz Osc.
A4Q4	2N3638	Emitter Follower

(Cont'd)

TABLE 1-2. TRANSISTOR, DIODE, AND CRYSTAL COMPLEMENT (Cont'd)

Reference Designation Symbol	Type	Function
Transistors (cont, d)		
A4Q5, A4Q6	2N3638	5-kHz Marker Gen.
A5Q1	2N3638	Emitter Follower
A5Q2	2N3565	Amplifier
A5Q3	2N3642	Amplifier
A5Q4	2N3642	Emitter Follower
A6Q1	2N3564	Clapp Osc.
A6Q2	2N3638	Amplifier
A6Q3	2N3638	Emitter Follower
A6Q4	2N3642	Sawtooth Gen.
A6Q5	2N3638	
A6Q6	2N1671B	
A7Q1	2N3564	I-f Amplifier
A7Q2	2N3642	I-f Amplifier
A7Q3, A7Q4	2N3564	Log/Lin Amplifier
A7Q5, A7Q7, A7Q8, A7Q9	2N3564	Log Amplifier
A7Q6	2N3642	Lin Amplifier
A7Q10, A7Q11	2N3565	Difference Amplifier
A7Q12	2N3638A	Video Amplifier
A7Q13	2N3642	Emitter Follower
A8Q1, A8Q2	2N3638	Dual Emitter Follower
A8Q3, A8Q4, A8Q5	2N3638	Compound Emitter Follower
A8Q6	2N3638	Amplifier
A8Q7, A8Q8, A8Q9	2N3638	Compound Emitter Follower
A8Q10, A8Q11, A8Q12	2N3638	Compound Emitter Follower
A8Q13, A8Q14, A8Q15	2N3638	Compound Emitter Follower
A9Q1	2N2996	1st Mixer
Diodes		
A2CR1, A2CR2	1N906	Clamp
A2CR3	ZD2.4B (Diodes, Inc.)	Constant Voltage Drop

(Cont'd)

TABLE 1-2. TRANSISTOR, DIODE, AND CRYSTAL COMPLEMENT (Cont'd)

Reference Designation Symbol	Type	Function
	Diodes (cont'd)	
A3CR1, A3CR2, A3CR3 A3CR4	FDH666 (Fairchild)	Balanced Mixer Diodes
A6CR1	V-900 (Solitron)	Variable Capacitor
A6CR3	ZD4. 7B (Diodes, Inc.)	Constant Voltage Drop
A7CR1, A7CR3, A7CR5, A7CR7, A7CR9, A7CR11, A7CR13	1N251	Diode Detector
A7CR2, A7CR4, A7CR6, A7CR8, A7CR10, A7CR11, A7CR14	1N251	Clamp
A8CR1, A8CR2, A8CR3, A8CR4, A8CR5, A8CR6	1N251	Resolution Control
	Crystals	
A3Y1	-	3-MHz Oscillator
A3Y2	-	3.002-MHz Oscillator
A4Y1	-	500-kHz Oscillator
A8Y1, A8Y2, A8Y3	-	100-kHz Filter

SECTION II
OPERATION

2-1. GENERAL.

2-2. This section contains installation and operating instructions for the Panalyzor. The Panalyzor has been factory tested and aligned and is shipped in a ready-to-operate condition. However, no attempt should be made to install or operate the unit until the operator is thoroughly familiar with the contents of this section. Figure 2-1 is an outline dimension drawing of the Panalyzor.

2-3. INSTALLATION.

2-4. To install the Panalyzor in the Model MF-5 Main Frame, insert the Panalyzor in the cavity and firmly seat it in place. If any resistance is noted while inserting the Panalyzor, withdraw it and examine the connectors on the rear of the Panalyzor and the rear wall of the main frame cavity for proper alignment. When properly installed, the Panalyzor front panel should be flush with the main frame panel. Tighten the front-panel fastener on the Panalyzor to mechanically secure it to the main frame.

2-5. OPERATION.

2-6. OPERATING CONTROLS AND CONNECTORS. The operating controls and connectors for the Panalyzor are described in table 2-1 and shown in figure 2-2.

2-7. TURN-ON PROCEDURES. The Panalyzor receives power from the Model MF-5 Main Frame. Therefore the turn-on procedures are given in the instruction manual for the main frame.

2-8. PRE-OPERATING CHECKS AND ADJUSTMENTS. Prior to operating the Panalyzor, perform the following checks and adjustments:

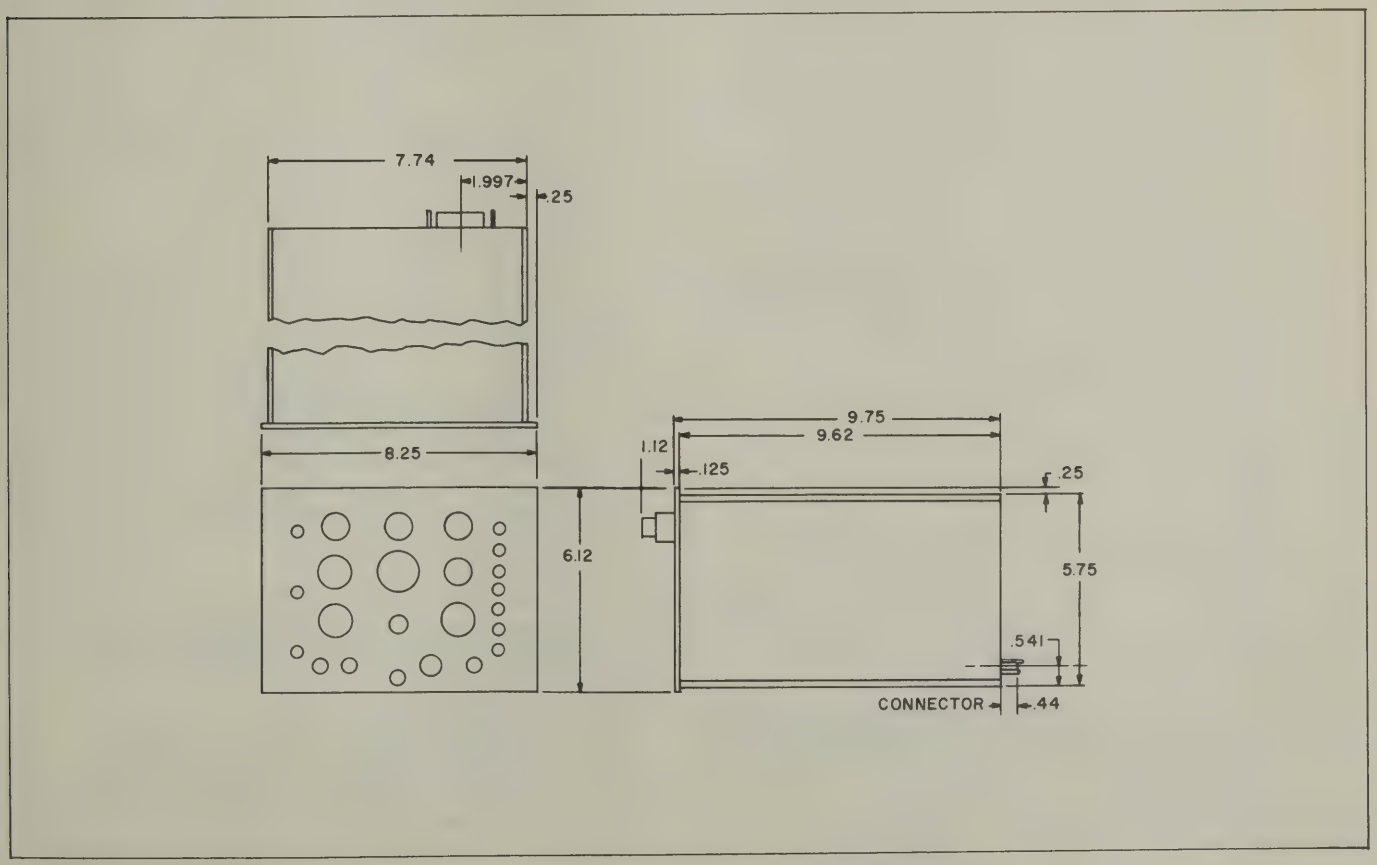


Figure 2-1. Outline Dimension Drawing, Panalyzor

TABLE 2-1. OPERATING CONTROLS AND CONNECTORS

Index No. (Figure 2-2)	Reference Designation	Name	Function
1	S2	VIDEO FILTER switch	Provides two degrees of video filtering (MIN and MAX) to suppress such unwanted effects as noise, spurious beating between closely spaced signals, hum, etc., on the signal(s) displayed on the CRT. Usable only in the VAR position of the FREQ SCALE-Hz/DIV switch. Video filtering is automatically selected in the other positions of the switch.
2	S7	TEST SIGNAL-Hz switch	Provides test signals to the Panalyzor. In the CF position of the switch, a 500-kHz test signal is applied to the input of the Panalyzor to locate its center frequency. In the 5K position of the switch, a 5-kHz signal (rich in harmonics) modules the 500-kHz test signal to provide 5-kHz markers on the CRT for setting up sweep width. In the 3.0M and 3.002M position, a two-tone r-f test signal (3.0 and 3.0002 MHz) is mixed with a 3.5-MHz VFO input to display a two-tone signal on the CRT. This position of the switch is used to check the odd-order distortion products of the Panalyzor.
3	R15	CENTER FREQ LEVEL control	Adjusts the level of the 500-kHz test signal applied to the Panalyzor.
4	R7	FREQ SCALE control	Adjusts the sweep width of the Panalyzor from 0 to 100 kHz when the FREQ SCALE-Hz/DIV switch is set to VAR.
5	R13	IF BANDWIDTH control	Adjusts the i-f bandwidth of the Panalyzor when the FREQ SCALE-Hz/DIV switch is set to VAR. CCW rotation of the control narrows the i-f bandwidth and CW rotation broadens the bandwidth.
6	S1	FREQ SCALE-Hz/DIV switch	Provides five preset sweep widths (150 Hz, 500 Hz, 3.5 kHz, 7 kHz, and 14 kHz) or variable sweep width (0 to 100 kHz) in the Panalyzor. In the preset positions, the i-f bandwidth is automatically set for optimum resolution; and the sweep rate for the 150-Hz and 500-Hz preset sweep widths is 0.1 Hz, while the sweep rate for the other preset positions is 1 Hz. In the VAR position of the switch, the i-f bandwidth, sweep width, and sweep rate are variable.
7	S6	SWEEP RATE-Hz switch	Selects either a 0.1 to 1.5-Hz or 1.5 to 30-Hz sweep rate range in the Panalyzor for the VAR position of the FREQ SCALE-Hz/DIV switch.
8	R11	VARIABLE control	Operates in conjunction with the SWEEP RATE-Hz switch to vary the sweep rate on the CRT when the FREQ SCALE-Hz/DIV switch is set to VAR.

(Cont'd)

TABLE 2-1. OPERATING CONTROLS AND CONNECTORS (Cont'd)

Index No. (Figure 2-2)	Reference Designation	Name	Function
9	R4 R2	CENTER FREQ 2 COARSE AND FINE controls	Determines the center frequency of the Panalyzor when the FREQ SCALE-Hz/DIV switch is set to either 350, 700, 1.4K or VAR.
10	A10S1 through A10S7	ATTENUATOR switches	Provide attenuation of 1, 2, 4, 8, 15, 20 and 20 dB at the input of the Panalyzor. When the switches are in the IN position, the indicated attenuation is inserted.
11	R1	GAIN control	Adjusts the amplitude of the indication on the CRT. Maximum gain is obtained with the control set to the maximum CW position. This control should be operated near maximum for measurements requiring the full 60 dB dynamic range of the Panalyzor.
12	J12	SIGNAL INPUT-3 VRMS jack	Connects signal(s) to be analyzed to the Panalyzor.
13	J11	PROBE jack	Provides operating power to the optionally available PRB-50 Probe when in use.
14	S6	SWEEP MODE switch	Selects either the normal sweep rate for the five preset sweep width positions of the FREQ SCALE-Hz/DIV switch, a faster sweep rate (1 Hz) for the 15-Hz and 50-Hz preset sweep widths of the FREQ SCALE-Hz/DIV switch, or a manual sweep for all the positions of this switch.
15	J10	VFO INPUT jack	Connects the external VFO input to the Panalyzor.
16	J9	EXT CF MOD jack	Connects an external modulation (frequency markers) to the Panalyzor for the CF position of the TEST SIGNAL-Hz switch.
17	S4	IF ATTENUATOR switch	Inserts either 20 dB or 0 dB of attenuation in the i-f amplifier of the Panalyzor. The switch must always be in the 0 dB position when making low level distortion measurements, thereby permitting the full 60 dB dynamic range of the Panalyzor to be used.
18	R5	MANUAL SWEEP control	Permits manual control of the CRT sweep when the SWEEP MODE switch is set to MANUAL.
19	S3	AMPLITUDE SCALE switch	Selects either LIN (linear) or LOG (logarithmic) voltage-amplitude scale of CRT display.
20	R10	CENTER FREQ 1 control	Determines the center frequency of the Panalyzor when the FREQ SCALE-Hz/DIV switch is either in the 15 or 50 position.

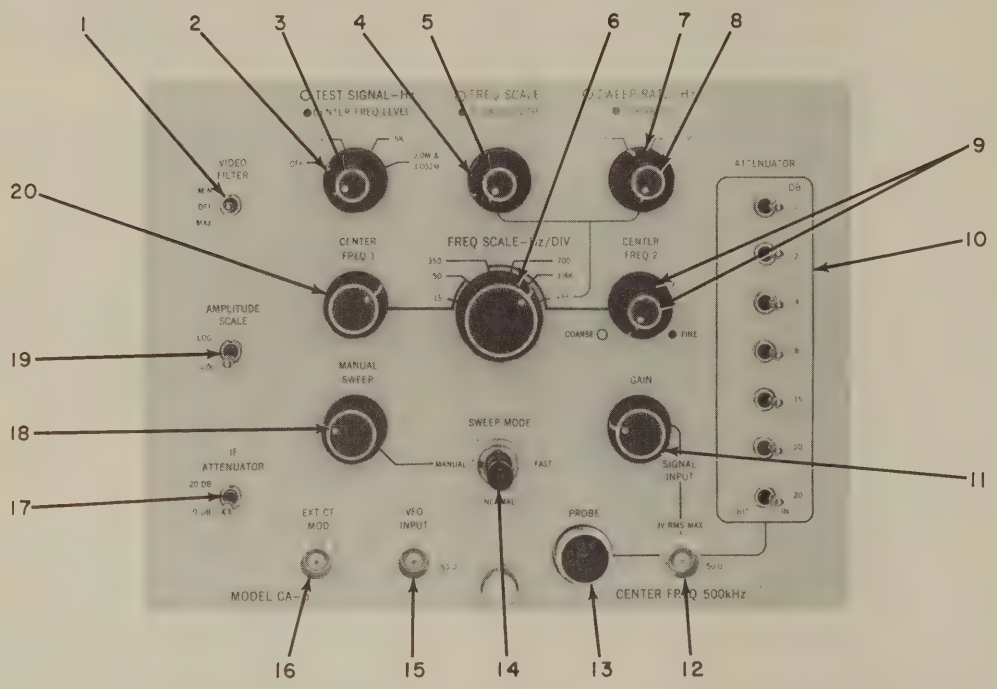


Figure 2-2. Operating Controls and Connectors

a. Set the front panel controls on the Panalyzor and MF-5 as indicated below.

Panalyzor

FREQ SCALE-Hz/DIV switch	VAR
FREQ SCALE control	Fully CW
IF BANDWIDTH control	Fully CW
GAIN control	Fully CW
SWEEP RATE-Hz switch	1. 5-30
VARIABLE control	Fully CW
TEST SIGNAL-Hz control	OFF
AMPLITUDE SCALE switch	LOG
IF ATTENUATOR switch	20 db
VIDEO FILTER switch	OFF

Panalyzor (Cont'd)

SWEEP MODE switch	NORMAL
ATTENUATOR switches	All in the OUT position

MF-5

SCALE ILLUMINATION control	Rotated CW until the CRT graticule illuminates sufficiently
FOCUS control	Adjusted for sharpest trace on the CRT
BRIGHTNESS control	As desired
VERT. POS control	Adjusted so that the baseline trace coincides with the frequency scale
HORIZ POS control	Adjusted to approximately center the baseline trace on the CRT

b. Set the TEST SIGNAL-Hz switch to CF and adjust the CENTER FREQ LEVEL control until a full-scale signal pip is displayed on the CRT. (The GAIN control and ATTENUATOR switches may be used to reduce the CF signal level, if necessary.)

c. Rotate the FREQ SCALE control in a CCW direction until the pip opens up into a horizontal line. Adjust the CENTER FREQ 2 COARSE and FINE controls, as required, for maximum height of the trace.

d. Rotate the FREQ SCALE control to the fully CW position. Adjust the HORIZ POS control to center the pip. Set the FREQ SCALE-Hz/DIV switch to the 1.4K position and readjust the CENTER FREQ 2 controls, if necessary, to position the signal pip under the CF line.

e. Set the FREQ SCALE-Hz/DIV switch to 350. Readjust the CENTER FREQ 2 controls, if necessary, to position the signal pip under the CF line.

f. Set the FREQ SCALE-Hz/DIV switch to the 350, 700, 1.4K and then VAR position and note that the signal pip is approximately at the same point on the horizontal scale for each of these switch positions.

g. Set the FREQ SCALE-Hz/DIV switch to 15, the SWEEP MODE to MANUAL, and the CENTER FREQ LEVEL control to approximately its mid-position. Adjust the MANUAL SWEEP control until the dot on the CRT is under the CF line.

h. Carefully adjust the CENTER FREQ 1 control until the dot deflects upwardly and return to the baseline. Then, slowly adjust the CENTER FREQ 1 control in the opposite direction until the dot is at its maximum vertical deflection.

i. Adjust the CENTER FREQ LEVEL control or GAIN control for approximately a full-scale deflection of the CRT dot.

j. Set the SWEEP MODE control to FAST and slightly adjust the CENTER FREQ 1 control until the signal pip displayed on the CRT (which will be broadened and distorted) is about 2 divisions to the left of the CF line.

k. Set the SWEEP MODE switch to NORMAL and observe that the signal pip appears near the CF line.

l. Set the FREQ SCALE-Hz/DIV switch to 50 and observe that the signal pip is near the CF line. At the conclusion of this step, set the TEST SIGNAL-Hz switch to OFF.

2-9. SWEEP WIDTH CALIBRATION FOR VARIABLE SWEEP WIDTH MODE. The following procedure is recommended for setting up the sweep width when in the VAR position of the FREQ SCALE-Hz/DIV switch. The procedure assumes that the pre-operating checks and adjustments outlined in paragraph 2-8 have been performed.

a. Set the front panel controls on the Panalyzor as indicated in step a of paragraph 2-8, with the exception of SWEEP RATE -Hz, which should be 0.1 - 1.5.

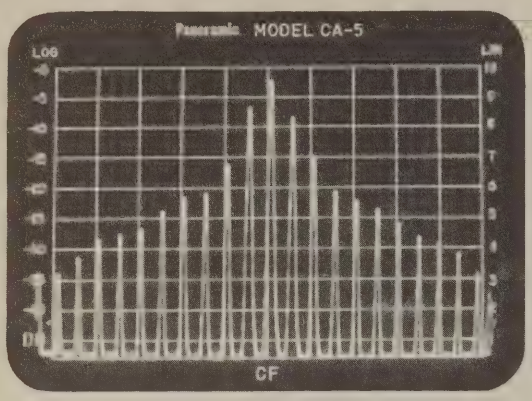
b. Set the TEST SIGNAL-Hz control to the 5K position and adjust the CENTER FREQ LEVEL control until 5-kHz markers are visible on the CRT. Adjust the IF BANDWIDTH control to resolve the pips clearly. Then adjust the FREQ SCALE control until the desired sweep width is obtained. At maximum sweep width (100 kHz), each CRT frequency calibration mark is equal to 10 kHz and markers should appear as illustrated in fig. 2-3A. For a 50-kHz sweep width, each CRT calibration mark is equal to 5 kHz and markers should appear as shown in fig. 2-3B. Figure 2-3C illustrates a CRT presentation for a 25-kHz sweep width (each CRT calibration mark is equal to 2.5 kHz).

c. After the desired sweep width is obtained, set the TEST SIGNAL-Hz control to the OFF position.

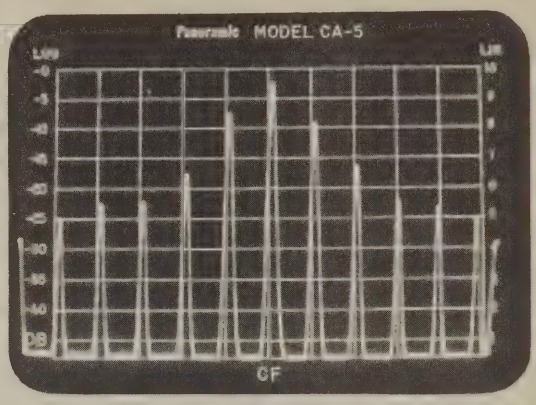
2-10. GENERAL OPERATING PROCEDURE. The following is a general operating procedure for the Panalyzor. The procedure assumes that the pre-operating checks and adjustments outlined in paragraph 2-8 have been performed and that an external VFO signal is being applied to the VFO INPUT jack on the Panalyzor.

CAUTION

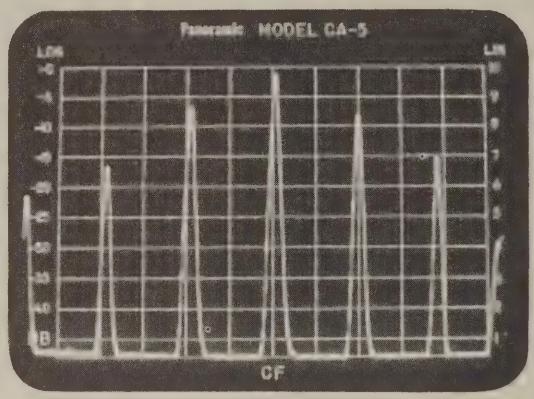
Do not apply a signal exceeding 3 volts (rms) to either the SIGNAL INPUT or VFO INPUT jack on the Panalyzor.



A. Sweep Width: 100 kHz



B. Sweep Width: 50 kHz



C. Sweep Width: 25 kHz

Figure 2-3. Typical CRT Marker Presentations for Variable Sweep Width Mode

Note

1. The frequency of the VFO signal must either be above or below the signal input to the Panalyzor by 500 kHz. A VFO signal that is 500 kHz above the signal input is preferable (to avoid the presence of image frequencies and spurious signal resulting from harmonics of the VFO signal) but not essential except for signal frequencies below 1.5 MHz. Above 1.50 MHz, no advantage is gained by using a VFO signal that is 500 kHz above the signal input, except that the displayed frequency will increase from left to right on the CRT.

2. Never use a VFO signal that is within the input-bandpass range (450 to 550 kHz) of the Panalyzor.

3. For frequencies below 2 MHz, use of the PANORAMIC Model REC-2 Range Extending Converter is recommended.

a. Set the front panel controls on the Panalyzor as indicated in step a of paragraph 2-8.

b. Couple the signal to be monitored to the SIGNAL INPUT jack, using either a 50-ohm coaxial cable (such as RG-58A/U) or the optionally available

PRB-50 Probe (when a high input impedance is required). Slowly search the spectrum with the external VFO until the signal appears at the center of the CRT screen. (It may be necessary to increase the output level of the applied VFO signal in order to locate the signal.)

Note

The external VFO frequency can be recognized as being either below or above the signal input frequency as follows: if the signal pip on the CRT moves from left to right as the VFO frequency is increased, the VFO frequency is below the signal input frequency; if the signal pip moves from right to left as the VFO frequency is increased, the VFO frequency is above the signal input frequency.

c. Once the signal is located, rotate the GAIN control in a CCW direction until the signal falls below full-scale deflection. (The ATTENUATOR switches may also be used to reduce the signal level.)

d. To determine the frequencies of signals displayed on the CRT, either: add the screen calibration of the given signal to the VFO frequency and subtract the input center frequency (500 kHz) of the Panalyzor from this total if the signal moves from right to left on the CRT as the VFO frequency is increased; or subtract the screen calibration of the given signal from the VFO frequency and add the input center frequency (500 kHz) to this difference if the signal moves from left to right as the VFO frequency is increased (i.e., Signal Freq. = VFO freq. ± Screen Calib. ± Input Center Freq.).

Example: With the Panalyzor set to maximum sweep width (100 kHz), a signal pip appears at the third frequency calibration mark (30 kHz) to the right of the CF mark on the CRT graticule. (On the 100 kHz sweep width, each frequency calibration mark is equal to a 10 kHz separation.) The VFO frequency is 2,450 kHz and when it is increased, the signal pip moves from right to left.

Sig. Freq = 2,450 kHz + 30 kHz
- 500 kHz = 1,980 kHz

e. The relative amplitudes of signals are proportional to the relative heights of the corresponding CRT deflections (within the limits specified for flatness of response). To observe signals of comparable amplitude (10:1 or less), set the AMPLITUDE SCALE switch to LIN. The LOG position of this switch is used to examine signals that are widely divergent in amplitude, allowing simultaneous reading of amplitudes having a 40 dB range.

2-11. NARROW BAND ANALYSIS. When the signals displayed on the CRT are so closely spaced in frequency that at full sweep width (100 kHz) their corresponding deflections on the CRT tend to merge into each other or mask one another, it may be possible to separate or resolve the signals by either: sharpening the i-f bandwidth and reducing the sweep width; reducing the sweep rate; or by doing both of the foregoing. The following procedure applies for the VAR position of the FREQ SCALE-Hz/DIV switch.

a. To increase the resolution capabilities by sharpening the i-f bandwidth and reducing the sweep width proceed as follows:

(1) Set the IF BANDWIDTH control maximum CW and center the band of signals of interest by adjusting the frequency of the external VFO.

(2) Spread the band of signals across the screen by turning the FREQ SCALE control in a CCW direction. Note that at reduced scanning width each frequency calibration mark represents a frequency separation equal to one-tenth of the reduced sweep width. Keep the band centered with the external VFO. (The CENTER FREQ 2 COARSE and FINE controls may be used for fine adjustments. However, avoid unnecessary changes of these control settings, since a loss of display may result when going to the 3.5-, 7-, and 14-kHz preset sweep widths.)

(3) Turn the IF BANDWIDTH control in a CCW direction until individual signals are most clearly resolved.

Note

1. Rotation of the IF BANDWIDTH control may result in increased or decreased pip height. When this occurs, return the pip amplitude to a suitable level with the GAIN control.

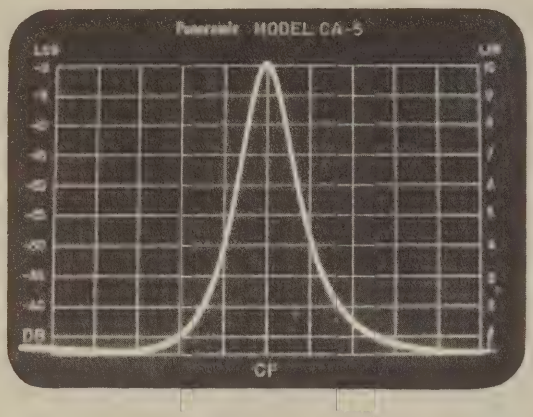
2. Optimum resolution can be recognized by the presence of "ringing" on one side of the signal pip as illustrated in figure 2-4. ("Ringing" can be seen more easily with the VIDEO FILTER switch set to OFF.) Turning the IF BANDWIDTH control in a CCW direction, after optimum resolution is obtained, will decrease the resolving capability and result in greatly reduced sensitivity.

b. To obtain better resolution by reducing the sweep rate, set the SWEEP RATE switch to either 0.1 - 1.5 or 1.5 - 30 (switch position selected determined by desired degree of frequency separation and nature of signals). Rotate the VARIABLE control in a CCW direction until optimum resolution is obtained.

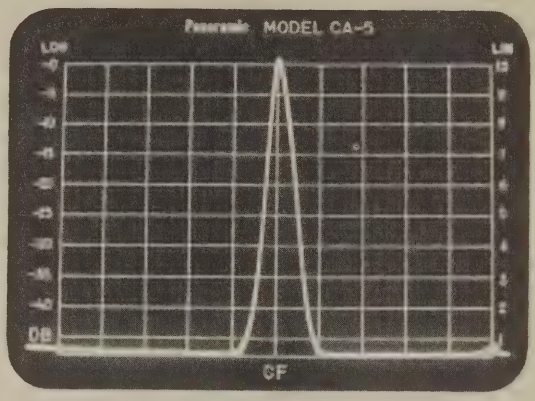
c. To obtain better resolution by sharpening the i-f bandwidth and reducing both the sweep width and sweep rate, proceed as follows:

(1) Repeat step a above.

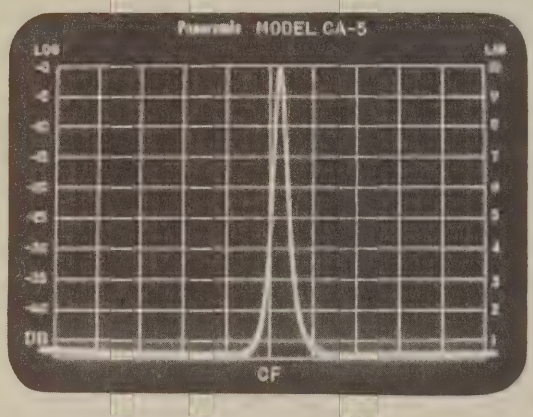
(2) Turn the IF BANDWIDTH and FREQ SCALE controls in a CCW direction and set the SWEEP RATE-Hz switch to either the 0.1 - 1.5 or 1.5 - 30 position. Rotate the VARIABLE control in a CCW direction until optimum resolution is obtained.



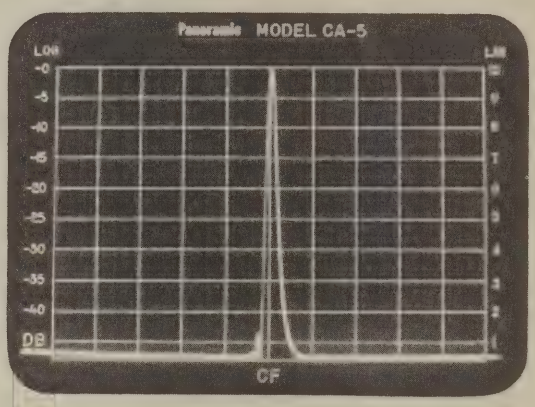
A. Narrow Sweep Width without Resolution (No Ringing)



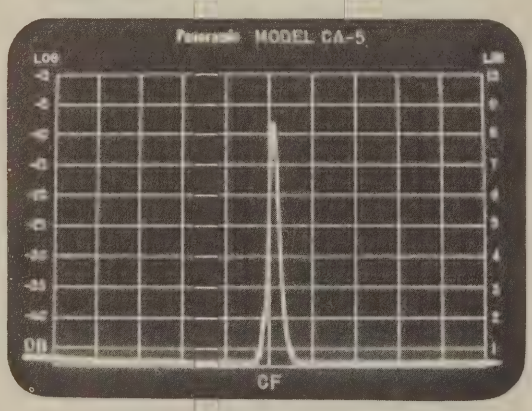
B. Wider Sweep Width without Resolution (No Ringing)



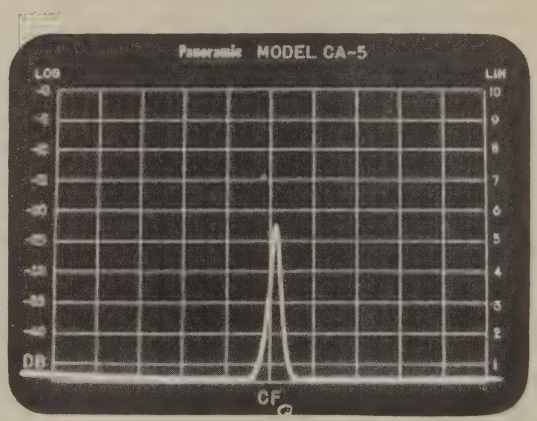
C. Under-resolved



D. Optimum Resolution



E. Over-resolved



F. Completely Over-resolved

Figure 2-4. Ringing as an Indication of Optimum Resolution

Note

If it is necessary to observe a given bandwidth at one time and the signals involved are so closely spaced that they cannot be completely resolved, maximum resolution is recognized by the appearance of the best defined screen presentation. Further counterclockwise rotation of the IF BANDWIDTH control will result in lessened resolution and loss of signal amplitude.

2-12. SINGLE SIDEBAND ANALYSIS. The following procedure describes how to use the Panalyzor to monitor signals from SSB transmitters, exciters, and receivers that are being checked out by the two-tone test method. The Panalyzor analyses these signals for intermodulation products, harmonic distortions, hum and noise, other spurious signals, etc.

a. Follow the operating procedures outlined in paragraph 2-10 and 2-11, as necessary, to display the monitored two-tone test signal on the CRT. Use a sweep width that is at least three times the separation between the two signals.

b. With the IF ATTENUATOR set to 20 dB and the AMPLITUDE SCALE switch set to LOG, set the ATTENUATOR switches, as required, to bring the highest pip on the screen to just over full-scale deflection. Then, adjust the GAIN control to obtain exactly a full-scale deflection of the highest pip on the CRT graticule.

c. Major in-band intermodulation components may now be read in reference to the level of the two tones. The two-tone level is considered the 0 dB reference amplitude for comparison over a 40 dB range. The calibrations on the left side of the CRT graticule (0 to 40 dB, in 5-dB increments) are read directly in terms of dB down. To examine distortion products from 40 dB to 60 dB below the signal level, set the IF ATTENUATOR switch to 0 dB. The upper dB portion of the display is now deflected off screen and the -20 dB to -60 dB portion is now displayed. Add 20 dB to the indicated reading to obtain the correct amplitude of the signals.

d. Odd-order distortion components are distributed symmetrically on either side of the main output signals and are located at separations equal to the frequency difference between them. The distortion components may be readily read as "dB down" from the reference levels. The third-order distortion components (first distortion pips) are usually the largest. Figure 2-5 illustrates a typical CRT presentation of a two-tone test.

2-13. TURN-OFF PROCEDURE. To turn off the Panalyzor, set the SCALE ILLUMINATION control on the MF-5 to the PWR OFF position.

2-14. PACKAGING INSTRUCTIONS.

2-15. The following packaging instructions provide information for short-term and long-term storage and shipment of the Panalyzor.

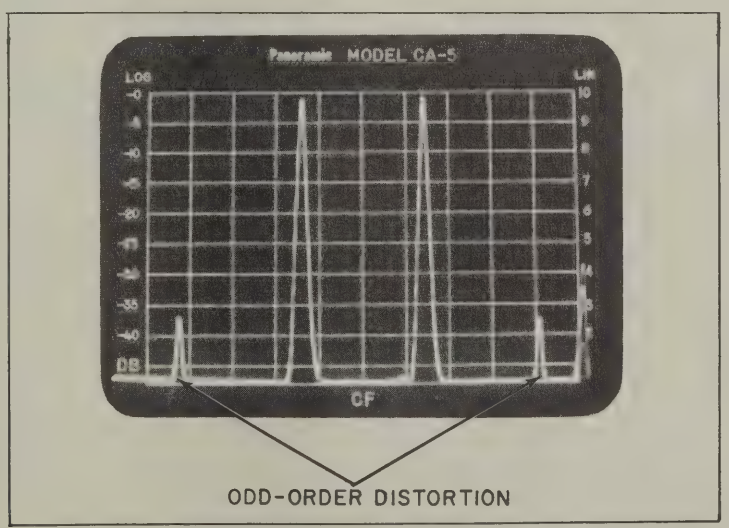


Figure 2-5. Typical CRT Presentation of Two-tone Test

2-16. SHORT-TERM PACKAGING. For short term packaging, the Panalyzor should be enclosed in a polyethylene bag and placed in a suitable carton for protection. The carton should be stored in a clean and moisture-free area. All accessories and literature should be securely fastened to the equipment in order to prevent loss.

2-17. LONG-TERM PACKAGING AND PACKAGING FOR SHIPMENT. Figure 2-6 illustrates the packaging procedure for the Panalyzor.

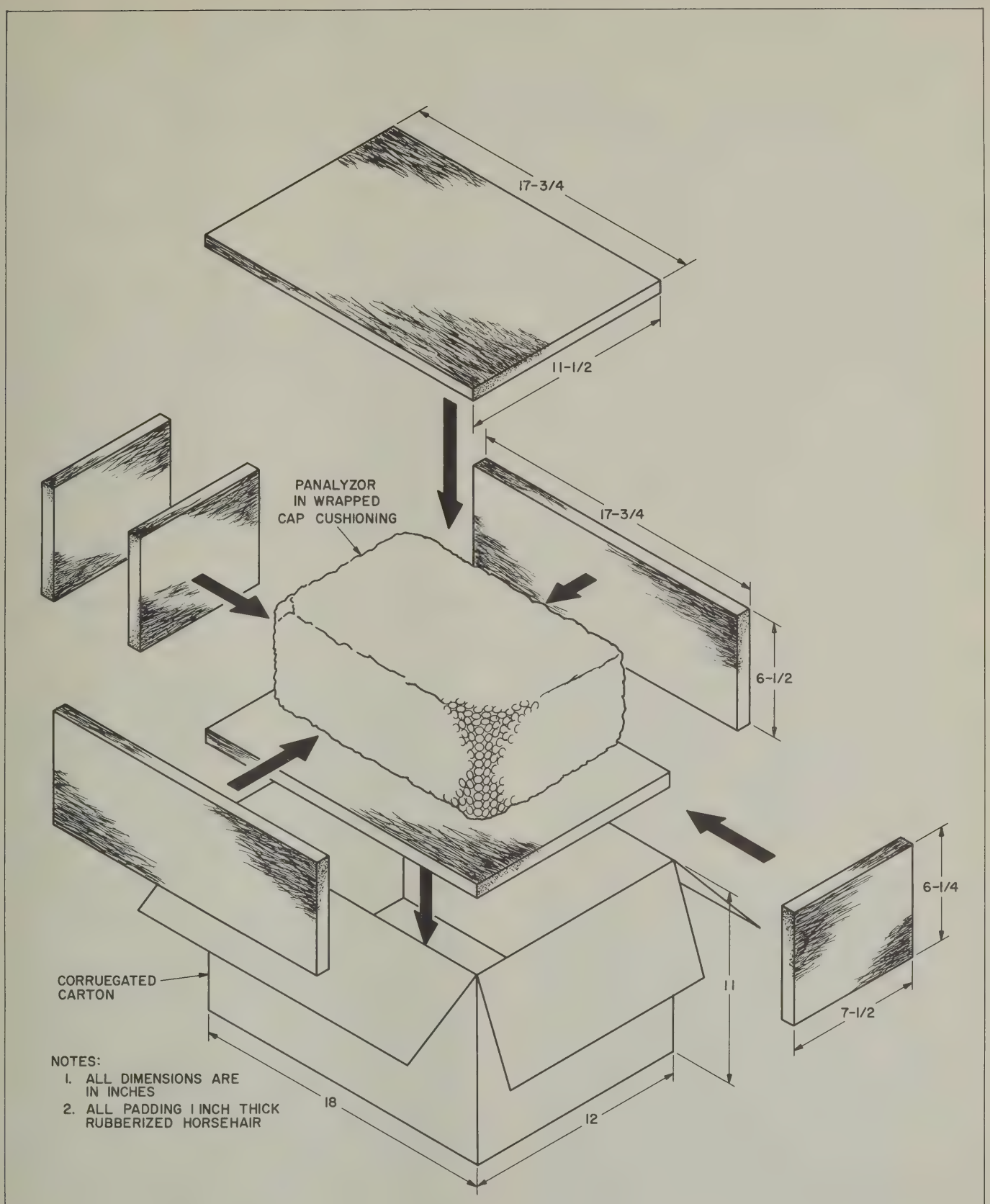


Figure 2-6. Packaging the Panalyzor

SECTION III
THEORY OF OPERATION

3-1. GENERAL.

3-2. This section contains the theory of operation for the Panalyzor. The Panalyzor is a completely solid-state narrow-band swept analyzer with an input center frequency of 500 kHz. It is basically a double-conversion superheterodyne receiver which is automatically and repetitively tuned about its 500-kHz center frequency, with the output displayed as vertical deflections on the CRT of its associated main frame. Because the horizontal sweep of the CRT is synchronized to the frequency of the swept local oscillator of the receiver, the vertical deflections are automatically positioned along the frequency-calibrated horizontal axis of the CRT screen. Operating power for the Panalyzor is provided by its associated main frame.

3-3. SIMPLIFIED BLOCK DIAGRAM ANALYSIS. (See figure 3-1.)

3-4. The signal under analysis is applied through the SIGNAL INPUT-3 VRMS jack on the front panel of the Panalyzor to an input attenuator network. This network, which operates in conjunction with the ATTENUATOR switches on the front panel, inserts sufficient attenuation in the signal path to maintain an on-scale display on the main frame CRT. The output of the attenuator is applied to the first mixer, where it is heterodyned with an external VFO signal (whose frequency is either 500 kHz above or below the incoming signal) to obtain the 500-kHz input center frequency of the Panalyzor. (An external VFO signal is not required when the incoming signal is within the 450 to 550 kHz frequency range.) From the first mixer the signal is then applied to a 500-kHz i-f amplifier which amplifies the signal and provides the Panalyzor with an input bandpass region of 450 to 550 kHz. A GAIN control in the output of the 500-kHz i-f amplifier enables smooth vernier control of the input signal amplitude. The output of the 500-kHz i-f amplifier is applied to the balanced mixer, where is it combined with the swept output of the local oscillator. The local oscillator operates above the output signal frequency of the 500-kHz i-f amplifier and can be swept from 550 to 650 kHz. An input discrete frequency combines with the swept local oscillator output to provide a continuously varying difference frequency that is repetitively swept from a point somewhat below 100 kHz to a point somewhat above 100 kHz. The i-f output of the mixer is applied to the 100-kHz crystal i-f amplifier. The i-f bandwidth is automatically set for optimum resolution in the preset sweep width positions of the FREQ SCALE-Hz/DIV (15, 50, 350, 700 and 1.4K) and is adjustable by the IF BANDWIDTH control, when the FREQ SCALE-Hz/DIV control is set to VAR. Reducing the i-f bandwidth reduces the portion of the local oscillator sweep that produces a signal within the bandpass of the 100-kHz crystal i-f amplifier; therefore the pip resulting from a discrete frequency input appears narrower on the main frame CRT, thereby improving the resolution between two signals that are close in frequency. The output of the 100-kHz crystal i-f amplifier is applied through the IF ATTENUATOR switch (which permits adjustment of the pip amplitudes on the CRT) to the log/lin amplifier. Within the log/lin amplifier the 100-kHz i-f signal is amplified and detected by linear or non-linear (log compression) circuits as determined by the AMPLITUDE SCALE switch. The log compression circuits produce a video output whose amplitude is logarithmically related to the amplitude of the applied i-f signal. The gain of the log/lin amplifier is varied to maintain a constant video output as the FREQ SCALE-Hz/DIV control is switched from one position to another. The video output signal of the log/lin amplifier is then applied to the vertical deflection circuits of the main frame; a smoothing filter is included in the output of the amplifier to suppress unwanted effects such as noise, spurious beating between closely spaced signals, hum, etc. The amount of smoothing (MIN or MAX) is controlled by the FREQ SCALE-Hz/DIV control for the five preset sweep ranges and by the VIDEO FILTER switch for the variable sweep mode.

3-5. The sawtooth generator produces the sawtooth waveform that is applied (via the sweep mode selection circuit) to the horizontal deflection circuits of the main frame and the local oscillator control circuit. The sweep rate of the sawtooth generator is normally fixed at 0.1 Hz for the 150- and 500-Hz preset sweep ranges and 1 Hz for the 3.5-, 7- and 14-kHz preset sweep ranges, as determined by the FREQ SCALE-Hz/DIV control. When in the VAR position ot his control, the sweep rate is adjustable from 0.1 to 30 Hz by operation of the SWEEP RATE-Hz switch and VARIABLE control. The sweep mode selection circuit, in conjunction with the SWEEP MODE control, performs one of the following: allows the sawtooth waveform to be applied to the main frame and local oscillator control circuit during normal automatic scan operation; selects a 1 Hz sweep rate instead of the normally used 0.1 Hz sweep rate for the 150- and 500-Hz preset sweep ranges for speed-up operation on these ranges; or disables the sawtooth generator and permits use of the MANUAL control for manual scan operation. When in automatic scan operation

and with the FREQ SCALE-Hz/DIV control set to any position other than the 150- and 500-Hz preset sweep ranges, the sawtooth generator output is combined with a dc voltage from the CENTER FREQ 2 COARSE and FINE controls within the local oscillator control circuit, adjusting the dc level of the applied sawtooth voltage. In the 3-, 5-, 7- or 14-kHz preset sweep ranges, an adjustable portion of the resulting sawtooth voltage is then applied to the local oscillator; in the variable sweep range, the entire sawtooth voltage or a portion of it is applied to the local oscillator as determined by the FREQ SCALE control. The local oscillator, consisting of a voltage-controlled multivibrator, is then swept over a range of frequencies, the actual range being determined by the sweep width selected by the FREQ SCALE-Hz/DIV control. When the FREQ SCALE-Hz/DIV control is set to either the 150- or 500-Hz preset sweep range, the sawtooth generator output is applied through the local oscillator control circuit and a portion of it is then combined with a dc level from the CENTER FREQ 1 control within the narrow band oscillator. The narrow band oscillator is then swept about its center frequency, over a limited range. The frequencies generated by the narrow-band oscillator synchronize the local oscillator so that it, too, is swept through the same limited range. Although its range of frequencies is limited, the narrow-band oscillator is used because of its greater stability which results in reduced jitter; this jitter would be quite noticeable with narrow sweep widths since small frequency differences result in large horizontal displacements.

3-6. Also included in the Panalyzor are the following self-test circuits: a 500-kHz crystal-controlled oscillator which applies a test signal to the Panalyzor to locate its center frequency; a 5-kHz marker generator which modulates the 500-kHz test signal to provide 5-kHz markers on the CRT for setting up sweep width; and a 3.0- and 3.002-MHz two-tone test generator for checking out the odd-order distortion of the Panalyzor. The output of a particular test circuit, which is selected by operation of the TEST SIGNAL-Hz control, is applied to the input side of the input attenuator. The CENTER FREQ LEVEL control adjusts the level of the 500-kHz test signal applied to the Panalyzor. An external audio signal can be used to modulate the 500-kHz test signal (via the EXT CF MOD jack), thereby providing frequency markers with a known separation.

3-7. DETAILED THEORY OF OPERATION.

3-8. The detailed theory of operation is subdivided into nine parts, in which the individual electronic assemblies are described. This description is based on the detailed block diagram, figure 3-2, the interconnection diagram, figure 5-1, and the individual schematic diagrams, figures 5-2 through 5-9.

3-9. INPUT ATTENUATOR ASSEMBLY A10 (see figure 5-2). The input attenuator consists of seven pi-connected resistive attenuators (R3 through R5, R6 through R8, R9 through R11, R12 through R14, R15 through R17, R18 through R20, and R21 through R23) that can be inserted or bypassed, depending on the positions of switches S1 through S7. The seven attenuators can insert 1, 2, 4, 8, 15, 20, and 20 dB attenuation, respectively, so that when all seven are connected in cascade, a total attenuation of 70 dB is inserted in the input circuit. Resistors R1 and R2 connect the outputs of the 500-kHz calibration oscillator and 5-kHz marker circuits (paragraph 3-17), and the two-tone generator circuit (paragraph 3-13), respectively, to the input side of the attenuator network.

3-10. FIRST MIXER ASSEMBLY A9 (see figure 5-2). The mixer comprises stage Q1. Mixing is accomplished within this stage by applying the output of the input attenuator to the base of Q1 and the external VFO signal from VFO INPUT jack J10 to the emitter. Since Q1 is being operated as a non-linear amplifier, the sum, difference (500 kHz) and two applied signals appear at its output.

3-11. 500-kHz I-F AMPLIFIER ASSEMBLY A5 (see figure 5-2). The 500-kHz i-f amplifier consists of a 500-kHz bandpass filter, emitter follower Q1, amplifiers Q2 and Q3, and emitter follower Q4. The 500-kHz bandpass filter provides a flat bandpass from 450 to 550 kHz, with a sharp cutoff above 550 kHz to reduce image response. Degenerative feedback is employed from emitter follower Q4 to amplifier Q2 (through R10 and R14) to stabilize the operation of the 500-kHz i-f amplifier. A filter network (C7 through C9 and L2) in the emitter circuit of Q4 prevents the local oscillator signal from being fed back to the i-f amplifier. The output of the i-f amplifier is continuously varied by the front-panel GAIN control R1.

3-12. TWO-TONE GENERATOR AND 2ND MIXER ASSEMBLY (see figure 5-3). The second mixer portion of assembly A3 consists of a balanced mixer and push-pull emitter follower Q1, Q2. The output from the 500-kHz i-f amplifier is applied directly to the balanced mixer, while the sweep local oscillator output is applied directly to the balanced mixer, while the sweep local oscillator output is applied to the mixer via the push-pull emitter followers. The balanced mixer employs four type FDH666 diodes (CR1 through CR4) in a balanced bridge configuration. When the 500-kHz i-f and local oscillator signals are applied to the mixer the non-linear characteristics of the mixer produce the sum and difference (100 kHz) of these signals, as well as the 500-kHz i-f signal. The local oscillator signal is effectively eliminated in the mixer output. The two-tone generator portion of assembly A3 comprises stages Q3 and Q4, both Pierce-type oscillator circuits. The oscillating frequencies of stages Q3 and Q4 are 3 and 3.002 MHz, respectively. When the TEST SIGNAL-Hz switch is set to the 3.0M and 3.002M position, both of these stages are energized and the resulting two-tone r-f output is applied through balancing potentiometer R15 to the signal input attenuator.

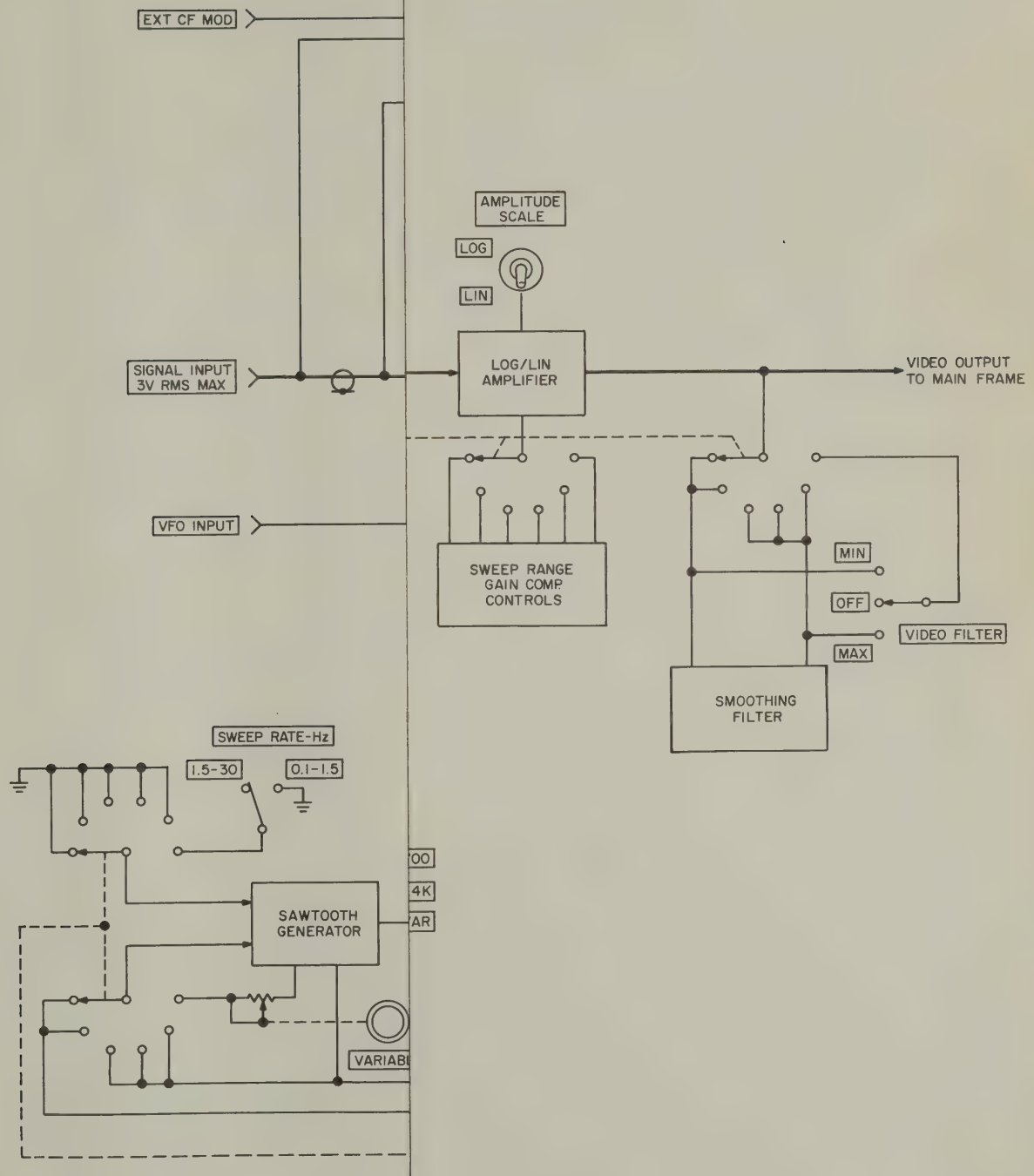


Figure 3-1. Simplified Block Diagram

and with the FREQ SCALE-Hz/DIV control set to any position other than the 150- and 500-Hz preset sweep ranges, the sawtooth generator output is combined with a dc voltage from the CENTER FREQ 2 COARSE and FINE controls within the local oscillator control circuit, adjusting the dc level of the applied sawtooth voltage. In the 3-, 5-, 7- or 14-kHz preset sweep ranges, an adjustable portion of the resulting sawtooth voltage is then applied to the local oscillator; in the variable sweep range, the entire sawtooth voltage or a portion of it is applied to the local oscillator as determined by the FREQ SCALE control. The local oscillator, consisting of a voltage-controlled multivibrator, is then swept over a range of frequencies, the actual range being determined by the sweep width selected by the FREQ SCALE-Hz/DIV control. When the FREQ SCALE-Hz/DIV control is set to either the 150- or 500-Hz preset sweep range, the sawtooth generator output is applied through the local oscillator control circuit and a portion of it is then combined with a dc level from the CENTER FREQ 1 control within the narrow band oscillator. The narrow band oscillator is then swept about its center frequency, over a limited range. The frequencies generated by the narrow-band oscillator synchronize the local oscillator so that it, too, is swept through the same limited range. Although its range of frequencies is limited, the narrow-band oscillator is used because of its greater stability which results in reduced jitter; this jitter would be quite noticeable with narrow sweep widths since small frequency differences result in large horizontal displacements.

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3-10. FIRST MIXER ASSEMBLY A9 (see figure 5-2). The mixer comprises stage Q1. Mixing is accomplished within this stage by applying the output of the input attenuator to the base of Q1 and the external VFO signal from VFO INPUT jack J10 to the emitter. Since Q1 is being operated as a non-linear amplifier, the sum, difference (500 kHz) and two applied signals appear at its output.

3-11. 500-kHz I-F AMPLIFIER ASSEMBLY A5 (see figure 5-2). The 500-kHz i-f amplifier consists of a 500-kHz bandpass filter, emitter follower Q1, amplifiers Q2 and Q3, and emitter follower Q4. The 500-kHz bandpass filter provides a flat bandpass from 450 to 550 kHz, with a sharp cutoff above 550 kHz to reduce image response. Degenerative feedback is employed from emitter follower Q4 to amplifier Q2 (through R10 and R14) to stabilize the operation of the 500-kHz i-f amplifier. A filter network (C7 through C9 and L2) in the emitter circuit of Q4 prevents the local oscillator signal from being fed back to the i-f amplifier. The output of the i-f amplifier is continuously varied by the front-panel GAIN control R1.

3-12. TWO-TONE GENERATOR AND 2ND MIXER ASSEMBLY (see figure 5-3). The second mixer portion of assembly A3 consists of a balanced mixer and push-pull emitter follower Q1, Q2. The output from the 500-kHz i-f amplifier is applied directly to the balanced mixer, while the sweep local oscillator output is applied directly to the balanced mixer, while the sweep local oscillator output is applied to the mixer via the push-pull emitter followers. The balanced mixer employs four type FDH666 diodes (CR1 through CR4) in a balanced bridge configuration. When the 500-kHz i-f and local oscillator signals are applied to the mixer the non-linear characteristics of the mixer produce the sum and difference (100 kHz) of these signals, as well as the 500-kHz i-f signal. The local oscillator signal is effectively eliminated in the mixer output. The two-tone generator portion of assembly A3 comprises stages Q3 and Q4, both Pierce-type oscillator circuits. The oscillating frequencies of stages Q3 and Q4 are 3 and 3.002 MHz, respectively. When the TEST SIGNAL-Hz switch is set to the 3.0M and 3.002M position, both of these stages are energized and the resulting two-tone r-f output is applied through balancing potentiometer R15 to the signal input attenuator.

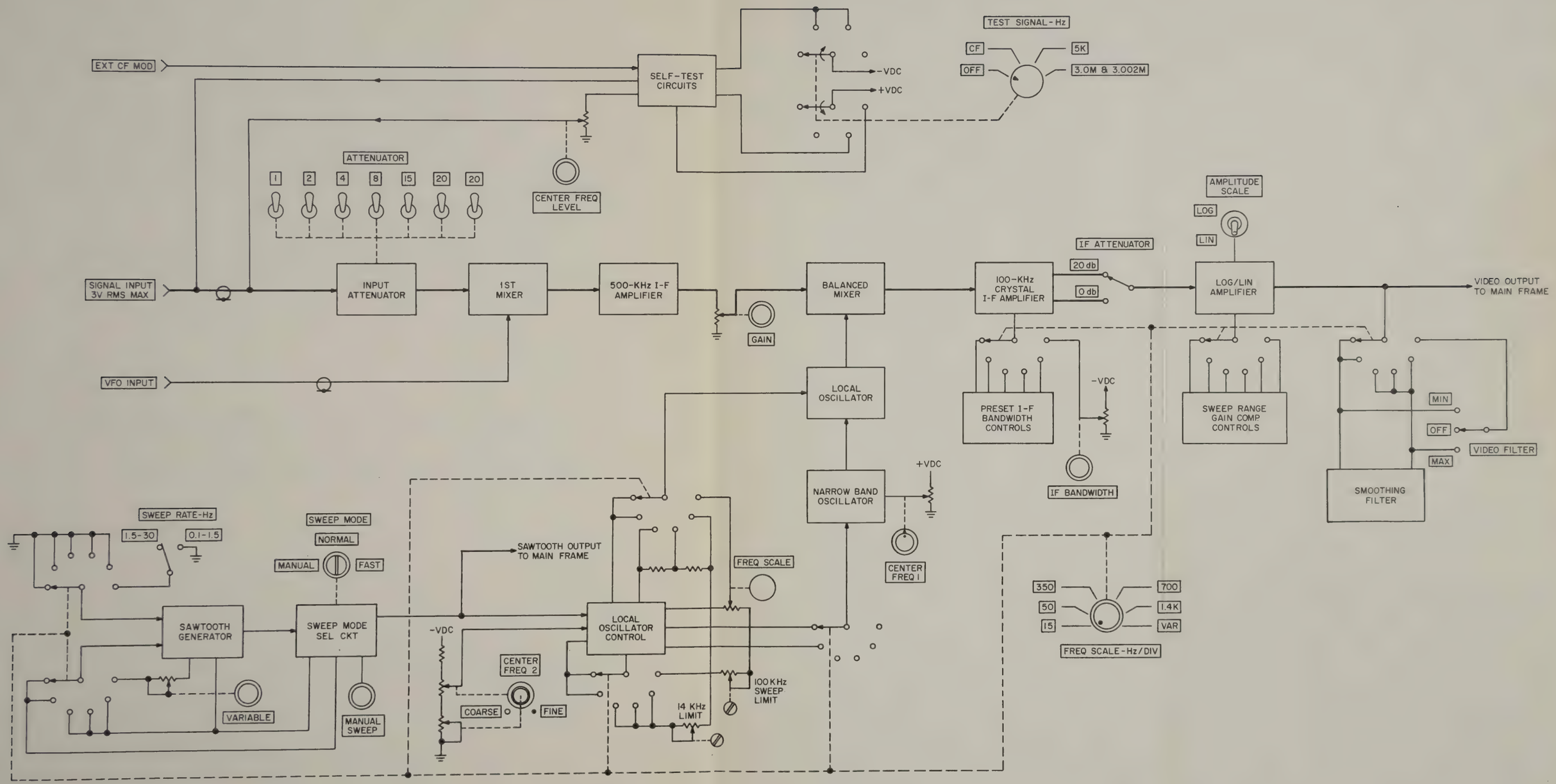


Figure 3-1. Simplified Block Diagram

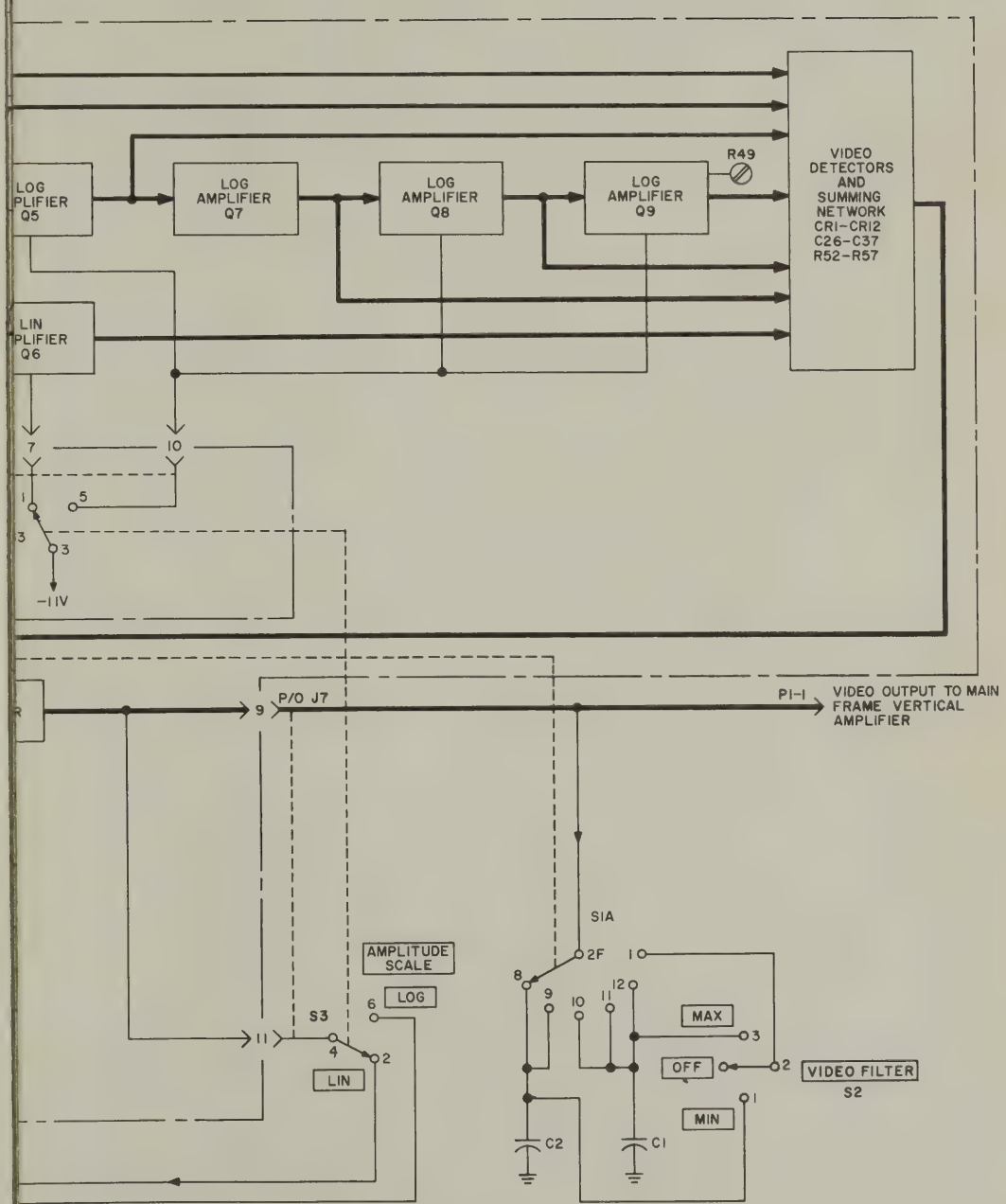


Figure 3-2. Detailed Block Diagram

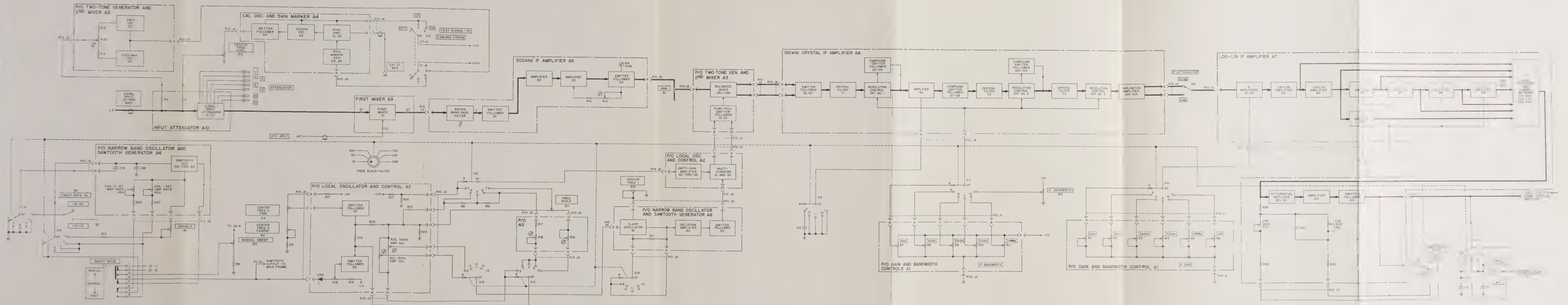


Figure 3-2. Detailed Block Diagram

3-13. 100-kHz CRYSTAL I-F AMPLIFIER ASSEMBLY A8 (see figure 5-4). The 100-kHz crystal i-f amplifier consists of three stages of i-f crystal filtering and a Darlington-type amplifier output stage (Q13 through Q15). Since the crystal filtering stages are similar, only one will be discussed. The output of the balanced mixer is coupled through emitter followers Q1 and Q2 to 100-kHz crystal filter Y1 and capacitors C4 and C5. The emitter followers provide a low impedance source for driving the crystal, while capacitor C4 neutralizes the effects of current flowing through the crystal holder capacity. The filter bandwidth is controlled by varying the "Q" of resolution transformer T1. Diodes CR1 and CR2, connected to an auxiliary (loading) winding of T1, function as loading diodes. These diodes are d-c biased to vary their dynamic impedance and thus the "Q" of transformer T1. Thus, the i-f bandwidth is varied by control of the d-c bias on the loading diodes. This d-c bias is obtained from preset bandwidth potentiometers A1R7 through A1R11 and front-panel IF BANDWIDTH control R13, as determined by the FREQ SCALE-Hz/DIV switch. Compound emitter follower Q3 through Q5, connected to another auxiliary winding of T1, maintains the output level essentially constant when varying the i-f bandwidth. The output of the final 100-kHz crystal filter stage is amplified by Darlington-type amplifier Q13 through Q15 and two outputs are applied to front-panel IF ATTENUATOR switch S4. When the IF ATTENUATOR switch is set to the 0 db position, the full output voltage of the amplifier is applied to log/lin assembly A7; when the switch is set to 20 db, one-tenth of the output voltage is applied to assembly A7.

3-14. LOG/LIN I-F AMPLIFIER ASSEMBLY A7 (see figure 5-5). The log/lin amplifier consists of two 100-kHz i-f amplifiers (Q1 and Q2), two log/lin amplifiers (Q3 and Q4), four log amplifiers (Q5 and Q7 through Q9), a lin amplifier (Q6), video detectors and summing network, a differential amplifier (Q10, Q11), a video amplifier (Q12), and an emitter follower (Q13). The output of 100-kHz i-f crystal amplifier assembly A8 is initially amplified by stages Q1 and Q2. The gain of stage Q2 is varied to maintain a constant output from assembly A7 when switching from one sweep width range to another. This is accomplished by inserting different preset potentiometers (A1R1 through A1R6) in the emitter by-pass circuit of Q2 for the different positions of the FREQ SCALE-Hz/DIV switch. The output of stage Q2 is further amplified by stages Q3 and Q4 before being simultaneously applied to log amplifier Q5 and lin amplifier Q6. Individual outputs from stages Q3 and Q4 are also applied to video detectors CR1/CR2 and CR3/CR4, respectively. When front-panel AMPLITUDE SCALE switch S3 is set to LOG, stages Q5 and Q7 through Q9 are energized and stage Q6 is deenergized. When this occurs, stages Q5, and Q7 through Q9 amplify the output of Q4 and their individual outputs are then applied in parallel to video detectors CR5/CR6, CR7/CR8, CR9/CR10, and CR11/CR12, respectively. The video detectors are voltage-doublers, for increased output level. The output of the video detectors are then added and the sum of these outputs (appearing at the junction of R57, R58, and R70) is applied to differential amplifier Q10, Q11. When the AMPLITUDE SCALE switch is set to LIN, stage Q6 is energized and stage Q5, and Q7 through Q9 are deenergized. This causes the output of Q6 to be applied to detector CR13/CR14 and added to the outputs of stages Q3 and Q4. The negative-going video input to the differential amplifier is then amplified by stages Q10, Q11 and Q12 and applied through emitter follower Q13 to the vertical deflection amplifiers in its associated main frame. A portion of the video output is fed back (degenerative feedback) through either log gain adjust R59 or lin gain adjust R61 to the differential amplifier, establishing the overall gain of assembly A7. Minimum and maximum video filtering are automatically selected for the five preset sweep width ranges of the FREQ SCALE-Hz/DIV switch. Front-panel VIDEO FILTER control S2 selects the degree of filtering when the FREQ SCALE-Hz/DIV switch is set to VAR.

3-15. NARROW BAND OSCILLATOR AND SAWTOOTH GENERATOR ASSEMBLY A6 (see figure 5-6). The sawtooth generator portion of assembly A6 consists of unijunction transistor Q6, linearity amplifier Q5, and emitter follower Q4. When in either of the five preset sweep width positions of the FREQ SCALE-Hz/DIV switch, capacitors C18 and C19 charge, with the voltage at which the unijunction transistor breaks down being determined by 10-second sweep rate adjust R24 (150 and 500-Hz preset sweep width) or 1-second sweep rate adjust R26 (3.5-, 7-, and 14-kHz preset sweep width). When the capacitors charge to this voltage, the unijunction transistor conducts and discharges the capacitors, completing one sawtooth cycle. Linearity amplifier Q5 and emitter follower Q4 provides the capacitors with a constant charging current, thereby obtaining a linear sawtooth sweep output from the sawtooth generator. When the FREQ SCALE-Hz/DIV switch is set to VAR, capacitor C19 is either switched in or out of the charging circuit, as determined by SWEEP RATE-Hz switch S6, and front-panel VARIABLE control R11 adjusts the sweep rate within the limits selected by switch S6. The sawtooth output is applied to assembly A2 and the horizontal deflection amplifiers of the associated main frame. When front-panel SWEEP MODE switch S6 is set to MANUAL, the sweep generator is disabled (by removal of its +21-volt supply) and a d-c voltage from front-panel MANUAL SWEEP control R5 is applied to assembly A6 and the main frame. The narrow band oscillator portion of assembly A6 consists of Clapp oscillator Q1, isolation amplifier Q2, and emitter follower Q3. When the FREQ SCALE-Hz/DIV switch is set to either the 150- or 500-Hz preset sweep width position, resistor R7 is shorted out, and oscillator Q1 is energized. The tuned circuit of Q1 contains varactor CR1, whose capacitance is a function of the instantaneous voltage applied. The voltage applied to CR1 is the sawtooth output obtained from assembly A2 (paragraph 3-16). In addition, the tuned circuit of Q1 contains inductor L1 and front-panel CENTER FREQ 1 control R10, which adjust the tuned circuit so that its center frequency corresponds to the

center frequency of the local oscillator. The output of oscillator Q1 is applied through isolation amplifier Q2 and emitter follower Q3 to the local oscillator portion of assembly A2.

3-16. LOCAL OSCILLATOR AND CONTROL ASSEMBLY A2 (see figure 5-7). The local oscillator portion of assembly A2 consists of voltage-controlled multivibrator Q1, Q2. The multivibrator has a free running frequency of 600 kHz and it is swept about this frequency in accordance with either: the level of the sawtooth voltage applied to it from unity-gain amplifier Q3 through Q6 (FREQ SCALE-Hz/DIV switch is set to any position other than the 150- and 500-Hz preset sweeps); or the synchronizing frequencies applied to it from the narrow band oscillator (FREQ SCALE-Hz/DIV switch set to the 150- or 500-Hz preset sweep). When in the VAR position of the FREQ SCALE-Hz/DIV switch, the local oscillator can be swept from 550 to 650 kHz, as determined by the front-panel FREQ SCALE control R7. The control portion of assembly A2 consists of emitter followers Q7 and Q8 and unity-gain amplifier Q3 through Q6. Emitter Follower Q7 receives either a d-c control voltage from front-panel CENTER FREQ 1 FINE control R3 (FREQ SCALE-Hz/DIV switch set to any position other than the 150- and 500-Hz preset sweep widths) or zero input (FREQ SCALE-Hz/DIV switch set to 150- or 500-Hz preset sweep width); emitter follower Q8 receives the sawtooth output from the sawtooth generator. When the FREQ SCALE switch is set to either the 150- or 500-Hz preset sweep width position, the sawtooth output of Q8 is applied to the narrow band oscillator (via 150-Hz sweep adjust R21 or 500-Hz sweep adjust R22) and a d-c voltage (obtained at the junction of R26 and R27) is applied to unity-gain amplifier Q3 through Q6. This permits control of the local oscillator frequency by the narrow band oscillator output. When the FREQ SCALE-Hz/DIV control is set to the 3. 5-, 7-, and 14-kHz preset sweep width positions or variable sweep width position, the sawtooth output of Q8 is combined with the d-c output of Q7 and applied to the unity-gain amplifier for control of the local oscillator frequency.

3-17. CALIBRATION OSCILLATOR AND 5-kHz MARKER GENERATOR ASSEMBLY A4 (see figure 5-8). The calibration oscillator portion of assembly A4 consists of oscillator Q3 and emitter follower Q4. Stage Q3, a crystal oscillator operating at 500 kHz, is energized when the front-panel TEST SIGNAL-Hz switch is set to CF. The oscillator output is applied through emitter follower Q4 to the signal input attenuator. Front-panel CENTER FREQ LEVEL control R15 adjusts the level of the signal applied to the attenuator. The 5-kHz marker generator portion of assembly A4 comprises stages Q5 and Q6, a bridged-T resistance-capacitor oscillator, and dual amplifier Q1, Q2. When the TEST SIGNAL-Hz switch is set to 5K, both the calibration oscillator and 5-kHz marker generator are energized. The 5-kHz output of the oscillator is then applied through the Q2 section of the dual amplifier to stage Q3, modulating the 500-kHz calibration oscillator. An external marker generator can be used to modulate the 500-kHz calibration oscillator via the Q1 section of the dual amplifier (when using external modulation, the TEST SIGNAL-Hz switch must be set to the CF position).

SECTION IV
MAINTENANCE

4-1. GENERAL.

4-2. This section contains maintenance instructions for the Panalyzor. Procedures are given for visual inspection of the Panalyzor, for minimum performance test (to determine whether or not the module is operating within its specifications), for locating defective components in the module and for aligning the module. Voltage measurements are also included. No attempt should be made to repair internal components or make adjustments until the operator is thoroughly familiar with the information contained in this section.

4-3. With the exception of the minimum performance standards checks, all the procedures given in this section should be performed with the Panalyzor removed from the Main Frame, but connected electrically to it. The service cable provided with the Main Frame should be used for this purpose. In addition, some of the procedures require that one of the plug-in boards in the Panalyzor be removed from the module, but connected electrically to it. The extender boards provided with the Panalyzor should be used for this purpose.

4-4. TEST EQUIPMENT REQUIRED.

4-5. The test equipment required for the maintenance and alignment of the Panalyzor is listed in table 4-1. Equipment having similar characteristics may be substituted for those listed in the table.

4-6. PRELIMINARY INSPECTION.

4-7. Preliminary inspection of the equipment is performed with the Panalyzor removed from the Main Frame and without operating power applied. This type of check is designed to detect conditions that might otherwise lead to a breakdown. Frequent causes of equipment failure are overheating of components due to improper ventilation, accumulation of dust and dirt and/or loose connections and fittings. Inspection is carried out with emphasis on finding evidence of these conditions.

4-8. COMPONENT LOCATIONS. The location of components mentioned in the inspection routines, alignment and troubleshooting procedures are illustrated in figures 4-1 through 4-3.

4-9. PRELIMINARY INSPECTION ROUTINE. Table 4-2 lists the preliminary inspection routine for the Panalyzor.

4-10. MINIMUM PERFORMANCE STANDARDS CHECKS.

4-11. The minimum performance checks provide a quick and convenient means of determining

TABLE 4-1. TEST EQUIPMENT REQUIRED

Type of Equipment	Suggested Manufacturer Name and Model No.	Use
Frequency Counter	General Radio Model 1153-AP	Frequency measurements
Oscilloscope	Tektronix Model 531A with type B plug-in	General waveform analysis
VTVM	RCA Model WV-98C	Voltage measurements
Signal Generator	Hewlett-Packard Model 606A	Provides input signal for test and calibration
Test Oscillator	Hewlett-Packard Model 651A	Provides VFO input and external marker

(Cont'd)

TABLE 4-1. TEST EQUIPMENT REQUIRED (Cont'd)

Type of Equipment	Suggested Manufacturer Name and Model No.	Use
Step Attenuator, 50-ohm	Kay Model 432-C	Functions with signal generator to set level and check attenuator calibration
Stop Watch	Any Commercial Model	Checks sweep rate of Panalyzor

TABLE 4-2. PRELIMINARY INSPECTION ROUTINE

Item	Inspect For	Corrective Action
Module case and panels	Dirt and corrosion	Clean with cloth moistened with cleaning solvent (trichloroethylene or equivalent).
Knobs, screws, connectors and clamps	Looseness	Tighten.
Wiring	Dirt, dust, and/or corrosion	Clean with cloth, aerosol spray, syringe, or camel's hair brush using trichloroethylene or equivalent cleaning solvent.
Solder joints	Loose or cold solder connections; corrosion	Clean carefully and resolder.
Capacitors	Leaks, bulges, signs of aging	Replace.
All connectors	Looseness, bent or corroded contacts, signs of aging	Clean contacts with cloth moistened with cleaning solvent (trichloroethylene or equivalent).
Resistors	Cracks, chipping, blistering, discoloration, and other signs of overheating.	Replace. **Note** Insure that overheating is not due to other defective components.
Switches	Looseness	Tighten mounting hardware.

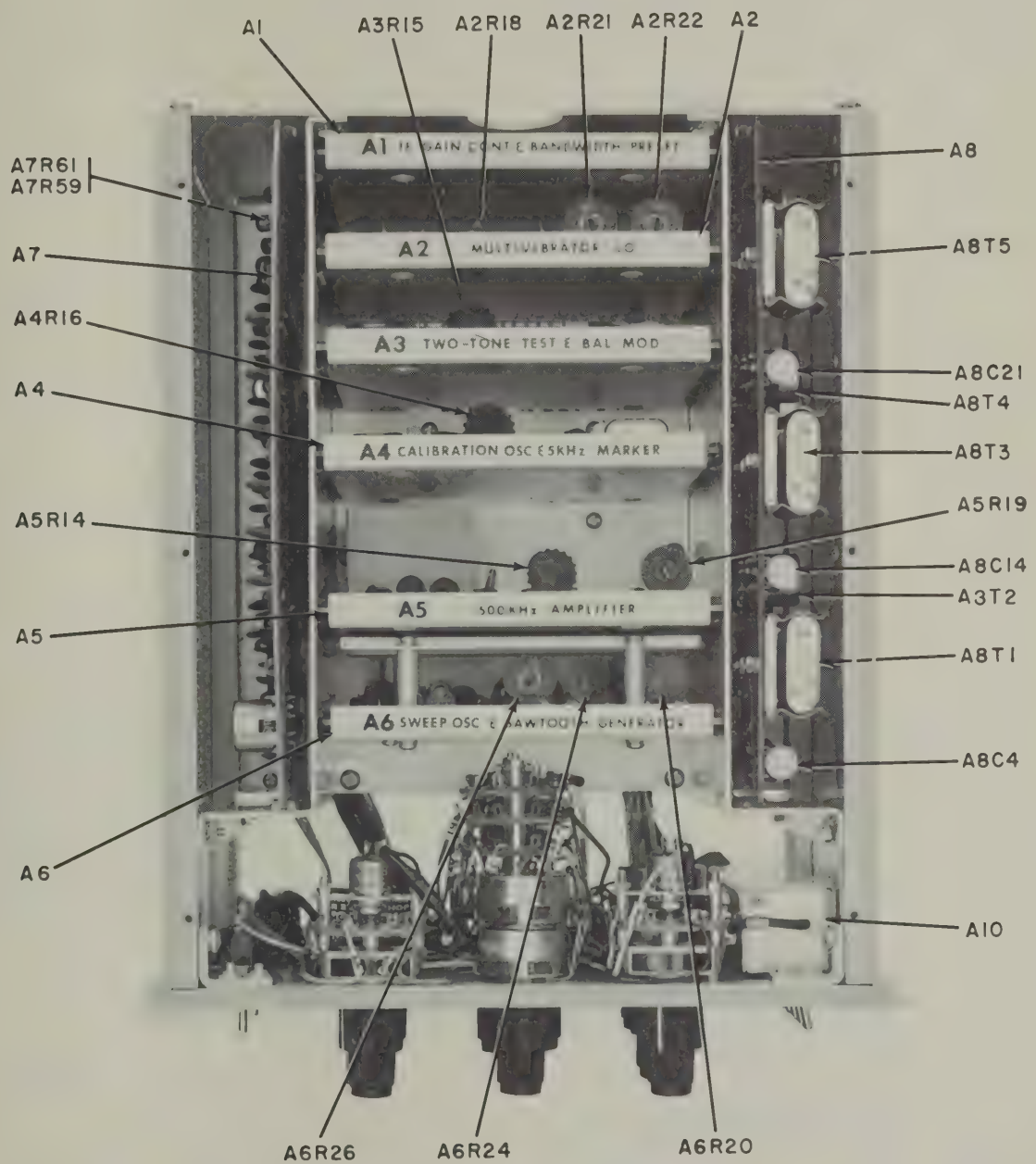


Figure 4-1. Panalyzor, Top View

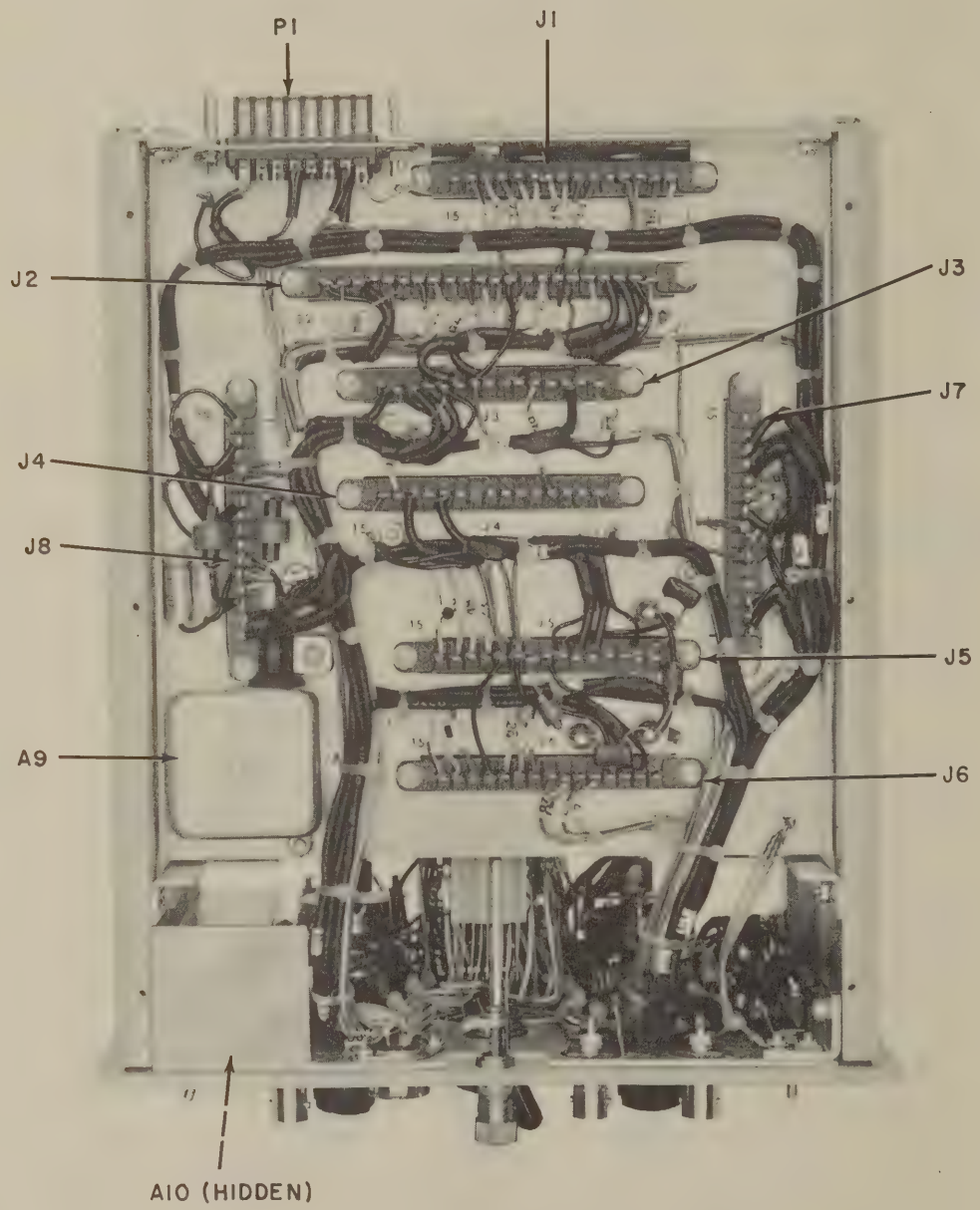


Figure 4-2. Panalyzor, Bottom View

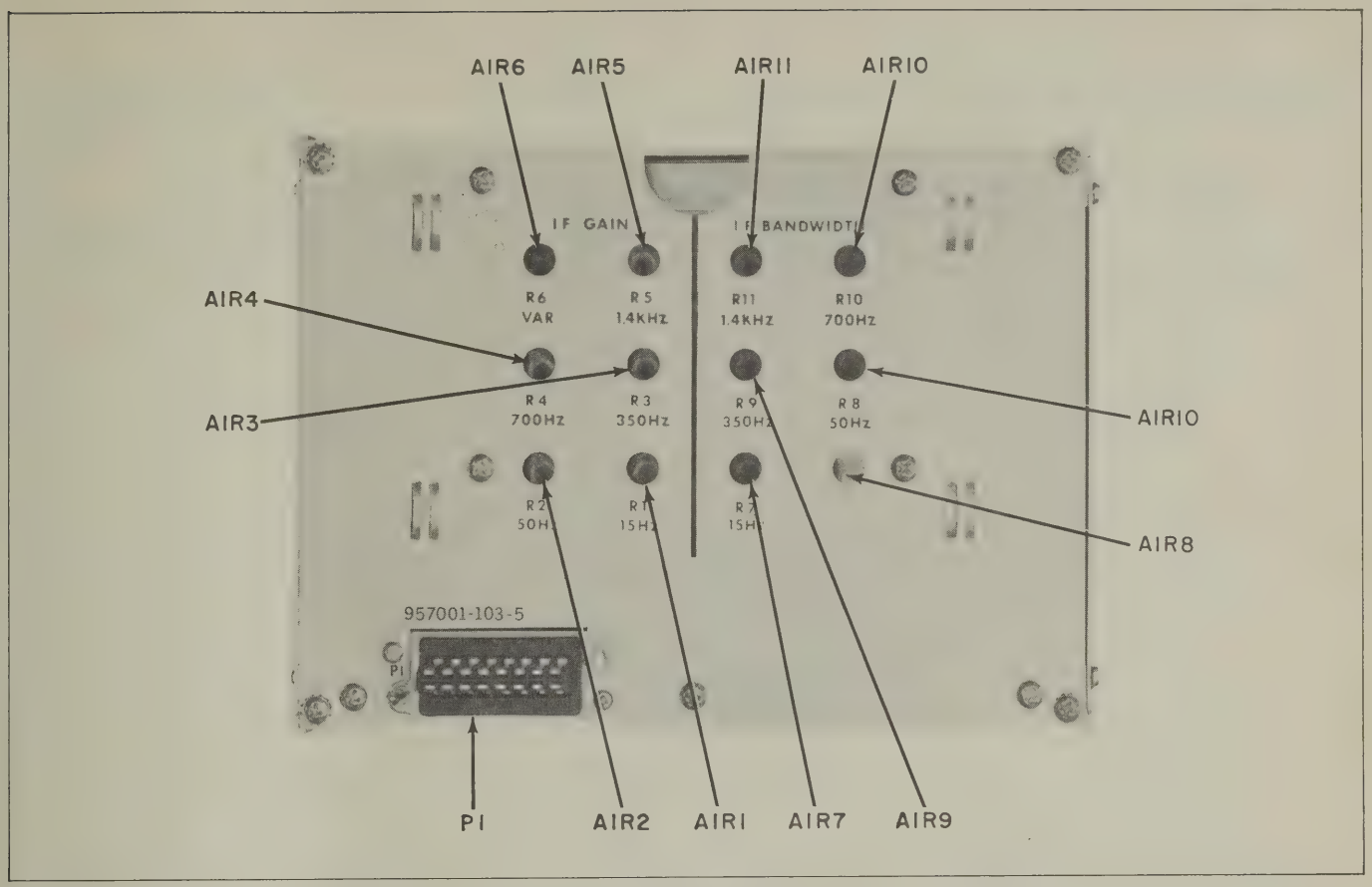


Figure 4-3. Panalyzor, Rear View

whether or not the Panalyzor is operating within its specifications. The quality of these checks presupposes that the Main Frame used in the test procedure is operating within acceptable limits; thus, procedures in the MF-5 manual should be performed prior to performing these checks. Figure 4-4 illustrates the equipment setup required to perform the minimum performance checks. Before performing these checks, set the front panel controls on the Panalyzor and Main Frame as indicated below and allow the equipment a 10-minute warmup period.

Panalyzor

FREQ SCALE-Hz/ DIV switch	VAR
FREQ SCALE control	Fully CW
IF BANDWIDTH control	Fully CW
GAIN control	Fully CW

Panalyzor

SWEEP RATE-Hz switch	1.5 - 30
VARIABLE control	Fully CW
TEST SIGNAL-Hz control	OFF
AMPLITUDE SCALE switch	LOG
IF ATTENUATOR switch	20 db
VIDEO FILTER switch	OFF
SWEEP MODE switch	NORMAL
ATTENUATOR switch	All in the OUT position

Main Frame	
SCALE ILLUMINATION control	Rotated CW until the CRT graticule illuminates
FOCUS control	Adjusted for a sharp trace on the CRT
BRIGHTNESS control	As desired

Main Frame	
VERT. POS control	Adjusted so that the baseline trace coincides with the frequency scale
HORIZ POS control	Adjusted to approximately center the baseline trace on the CRT

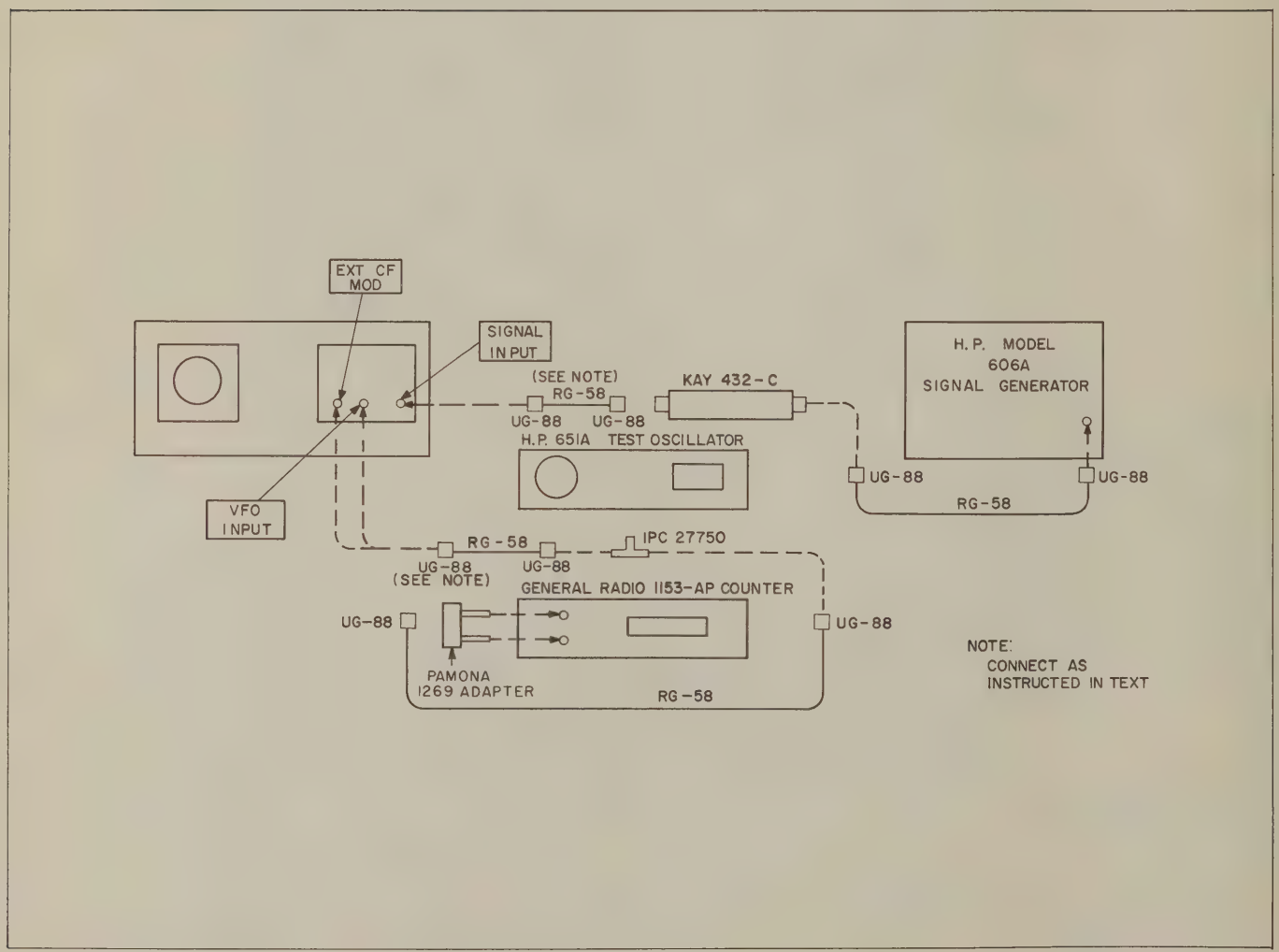


Figure 4-4. Minimum Performance Standards, Equipment Setup

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS

Step	Purpose	Procedure	Acceptable Indication
1	To check accuracy of sweep widths.	a. Set the TEST SIGNAL-Hz switch to CF and adjust the CENTER FREQ LEVEL and GAIN controls to display a full-scale signal pip on the CRT. Adjust the CENTER FREQ 2 COARSE and FINE controls until the pip is under the CF line engraved on the CRT. Connect the test oscillator output to the EXT CF MOD jack on the Panalyzor. Set the test oscillator frequency to 50 kHz, and adjust its frequency and output level until visible sideband pips are obtained at the extreme left and right screen calibrations. (A slight readjustment of the CENTER FREQ 2 controls may be necessary to position the sideband pips correctly.) Record the indication on the frequency counter.	a. The frequency counter indicates 50 ±5 kHz.
		b. Set the FREQ SCALE-Hz/DIV switch to the 1.4K position and repeat step a, using a test oscillator frequency of approximately 7 kHz.	b. Frequency counter indicates 7 kHz ±700 Hz.
		c. Set the FREQ SCALE-Hz/DIV switch to the 700 position and repeat step a, using a test oscillator frequency of approximately 3.5 kHz.	c. Frequency counter indicates 3.5 kHz ±350 Hz.
		d. Set the FREQ SCALE-Hz/DIV switch to the 350 position and repeat step a, using a test oscillator frequency of approximately 1.75 kHz.	d. Frequency counter indicates 1.75 kHz ±175 Hz.
		e. Set the FREQ SCALE-Hz/DIV switch to 50, and the SWEEP MODE switch to MANUAL. Adjust the MANUAL SWEEP control until the dot is under the CF line engraved on the CRT graticule. Slowly adjust the CENTER FREQ 1 control until the dot rises to a maximum. Return the SWEEP MODE switch to NORMAL and adjust the CENTER FREQ 1 control, as necessary, to place the signal pip under the CF line.	e. Frequency counter indicates 250 ±25 Hz.

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
1 (Cont'd)		Set the test oscillator frequency to 250 Hz, and adjust its frequency and output level until visible sideband pips are obtained at the extreme left and right screen calibrations. (A slight readjustment of the CENTER FREQ 1 control may be necessary to position the sideband pips correctly.) Record the indication on the frequency counter.	
		f. Set the FREQ SCALE-Hz/DIV switch to 15 position and repeat step e, using a test oscillator frequency of approximately 75 Hz.	f. Frequency counter indicates 75 ±7.5 Hz.
2	To check accuracy of sweep rate.	a. With the FREQ SCALE-Hz/DIV switch set to the 15 position, and using a stop watch, record the time required for two sweeps on the CRT.	a. Stop watch indicates from 18 to 22 seconds.
		b. Set the FREQ SCALE-Hz/DIV switch to the 1.4K position and record the time required for ten sweeps on the CRT.	b. Stop watch indicates from 9 to 11 seconds.
		c. Connect the frequency counter input to the X OUT connector on the rear of the MF-5. Set the FREQ SCALE-Hz/DIV switch to VAR and rotate the FREQ SCALE control fully cw. Record the frequency counter indication	c. Frequency counter indicates 30 Hz, minimum.
		d. Rotate the VARIABLE control fully CCW, and set the SWEEP RATE-Hz switch to the 0.1 - 1.5 position. Using the stop watch, record the time required for two sweeps on the CRT.	d. Stop watch indicates 20 seconds or more.
3	To check accuracy of LIN amplitude scale.	a. Disconnect the test oscillator from the EXT CF MOD jack and connect the signal generator (through the external attenuator which is set to 0 dB of attenuation) to the SIGNAL INPUT jack on the	a. Signal pip height is from 8.7 to 9.3 divisions on the LIN amplitude scale.

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
3 (Cont'd)		Panalyzor. Set the FREQ SCALE switch to 1.4K, the AMPLITUDE SCALE switch to LIN, the SWEEP RATE-Hz switch to 1.5 - 30, and the TEST SIGNAL-Hz switch to OFF. Rotate the FREQ SCALE and VARIABLE controls fully CW. Set the generator frequency to 500 kHz, at 200-uv output. Adjust the generator frequency and output level, as required, to obtain a full-scale signal pip at the center of the screen. Set in 1 dB of attenuation at the external attenuator and observe the signal pip height in LIN divisions on the CRT graticule.	
		b. Repeat step a with the following amount of attenuation inserted in the external attenuation:	b. Signal pip height is within the ranges indicated below on the LIN amplitude scale:
		(1) 2 dB (2) 3 dB (3) 4 dB (4) 5 dB (5) 6 dB (6) 8 dB (7) 10 dB (8) 14 dB (9) 20 dB	(1) From 7.7 to 8.3 divisions. (2) From 6.8 to 7.4 divisions. (3) From 6.1 to 6.7 divisions. (4) From 5.3 to 5.9 divisions. (5) From 4.7 to 5.3 divisions. (6) From 3.7 to 4.3 divisions. (7) From 3.0 to 3.6 divisions. (8) From 1.7 to 2.3 divisions. (9) From 0.7 to 1.3 divisions.
4	To check accuracy of LOG amplitude scale.	a. Set in 0 dB of attenuation at the external attenuator and set the AMPLITUDE SCALE switch to LOG. The pip should be at the -20 DB mark on the LOG amplitude scale of the CRT graticule. Increase the signal generator output level by 20 dB and adjust the level, as necessary, to obtain a full-scale signal pip on the CRT. Set in 5 dB attenuation at the external attenuator and observe the signal pip height on the LOG scale of the CRT graticule. (The 1-dB steps of the external attenuator may be used for more accurate interpolation between 5 DB screen markings.)	a. Signal pip is at the -4 to -6 DB mark on the LOG amplitude scale of the CRT graticule.

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
4 (Cont'd)		b. Repeat step a with the following amount of attenuation inserted in the external attenuator: (1) 10 dB (2) 15 dB (3) 20 dB (4) 25 dB (5) 30 dB (6) 35 dB (7) 40 dB	b. Signal pip is at the following mark on the LOG amplitude scale: (1) -9 to -11 DB (2) -14 to -16 DB (3) -19 to -21 DB (4) -24 to -26 DB (5) -29 to -32 DB (6) -33 to -37 DB (7) -38 to -42 DB
5	To check frequency response (flatness) of the Panalyzor.	Set the external attenuator to 0 dB, the AMPLITUDE SCALE switch to LIN, and the FREQ SCALE-Hz/DIV switch to VAR. Adjust the signal generator output level to obtain a full-scale signal pip on the CRT. While observing for the maximum and minimum pip amplitudes, adjust the signal generator frequency so as to move the signal pip between the left and right calibrated screen limits. Set the signal generator frequency to the frequency producing the maximum pip amplitude on the CRT and adjust the generator output level, as necessary, to obtain a full-scale pip on the CRT. Then set the signal generator to the frequency producing the minimum pip amplitude and observe the pip amplitude on the LIN scale.	The signal pip amplitude should be at least 9 divisions (LIN) for the frequency producing the minimum pip amplitude.
6	To check image rejection of the Panalyzor.	Set the signal generator frequency to 500 kHz (verify the frequency with the frequency counter, or by setting the TEST SIGNAL-Hz switch to CF to locate 500 kHz in the center of the screen). Adjust the generator output level until a full-scale signal pip is obtained on the CRT. Record the output level of the generator. Then set the signal generator frequency to 700 kHz and increase its level until a full-scale pip is obtained on the CRT; also record this output level of the generator. Divide the	$\frac{E_{700\ kHz}}{E_{500\ kHz}} > 100$

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
6 (Cont'd)		recorded signal generator output level at 700 kHz by the recorded output level at 500 kHz.	
7	To check i-f bandwidth and resolution.	a. Disconnect the signal generator from the SIGNAL INPUT jack. Set the TEST SIGNAL-Hz switch to CF, the AMPLITUDE SCALE switch to LIN, and the FREQ SCALE-Hz/DIV switch to 1.4K. Adjust the CENTER FREQ LEVEL, GAIN, and CENTER FREQ 2 controls for a full-scale signal pip on the CRT. Measure the width of the pip (in divisions) at 0.5 of full-scale deflection.	a. Width of signal pip, measured at 0.5 vertical graduation, should not be greater than 0.25 divisions.
		b. Repeat step a with the FREQ SCALE-Hz/DIV switch set to the following: (1) 700 (2) 350 (3) 50 } Use the CENTER FREQ 1 control to center the pip (4) 15 }	b. Width of signal pip should not be greater than: (1) 0.30 divisions (2) 0.45 divisions (3) 0.40 divisions (4) 0.7 divisions
		c. Set the AMPLITUDE SCALE switch to LOG. Adjust the CENTER FREQ LEVEL and/or GAIN control(s) to obtain a full-scale pip. Set the IF ATTENUATOR switch to 0 dB and measure the width of the pip at the -40 DB screen calibration mark on the LOG amplitude scale.	c. Width of signal pip, measured at -40 DB screen calibration mark, should not be greater than 6.0 divisions.
		d. Repeat step c with the FREQ SCALE-Hz/DIV switch set to the following: (1) 50 (2) 350 (3) 700 (4) 1.4K	d. Width of signal pip should not be greater than: (1) 3.0 divisions (2) 3.0 divisions (3) 2.2 divisions (4) 1.5 divisions
		e. Set the AMPLITUDE SCALE switch to LIN, the TEST SIGNAL-Hz switch to OFF, the IF ATTENUATOR switch to 20 dB, the FREQ SCALE-Hz/DIV switch to VAR, and the SWEEP RATE-Hz switch to 1.5 - 30.	e. The VARIABLE control should be at or above mid-position when the pips are resolved.

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
7 (Cont'd)		Connect the test oscillator to the VFO INPUT jack and the signal generator to the SIGNAL INPUT jack. Using the counter, set the test oscillator frequency to 500.00 kHz (or as close as practicable) and the signal generator frequency to 502.80 kHz (or as close as practicable). Adjust the output level of the generator and oscillator so that they produce equal amplitude signal pips at full-scale deflection. (Do not disturb their frequency settings.) The tops of the pips may have a "double-humped" shape. If so, adjust the IF BANDWIDTH control CCW so that the pips are no longer "double-humped" but not so far as to reduce their amplitudes. Adjust the VARIABLE control, as necessary, to produce two adjacent pips that intersect at or below the 0.7 scale line (LIN). Note the rotational position of the VARIABLE control after this display is produced.	
8	To check overall sensitivity of the Panalyzor.	a. Set the FREQ SCALE-Hz/DIV switch to 1.4K, and all the ATTENUATOR switches to their OUT position. Rotate the GAIN control to its fully CW position. Set the signal generator frequency to 2 MHz, at a 200-uv output, and the test oscillator frequency to 2.5 MHz, at approximately a 0.3-volt output. Adjust the test oscillator frequency, as required, to center the signal pip on the CRT. Then adjust the signal generator output level until a full-scale pip is obtained on the CRT. Record the signal generator output level.	a. The signal generator output level is 200 uv maximum.
		b. Set the FREQ SCALE-Hz/DIV switch to 700 and repeat step a.	b. Same as step a.
		c. Set the FREQ SCALE-Hz/DIV switch to 350 and repeat step a.	c. Same as step a.

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
8 (Cont'd)		d. Set the FREQ SCALE-Hz/DIV switch to 50. Use the CENTER FREQ 1 control to center the pip. Adjust the signal generator output level to obtain a full-scale signal pip on the CRT and record this level.	d. Same as step a.
		e. Set the FREQ SCALE-Hz/DIV switch to 15 and repeat step d.	e. Same as step a.
		f. Set the FREQ SCALE-Hz/DIV switch to VAR and the VARIABLE control fully CW. Adjust the IF BANDWIDTH control for a single-peaked pip on the CRT. Then adjust the signal generator output level to obtain a full-scale pip on the CRT. Record the signal generator output level.	f. Same as step a.
9	To check accuracy of calibrated attenuators.	a. Set the external attenuator to 70 dB and adjust the signal generator output level for a full-scale signal pip on the CRT. Set the 1 dB ATTENUATOR switch on the Panalyzor to its IN position and remove 1 dB from the external attenuator. Record the difference in dB between the attenuation inserted in the Panalyzor and the attenuation removed from the external attenuator (as indicated by the departure of the signal pip from full-scale LIN).	a. The dB difference is 0.05 dB max.
		b. Repeat step a, setting the following ATTENUATOR switches on the Panalyzor to the IN position and removing a corresponding amount of attenuation from the external attenuator:	b. The dB difference is as follows:
		(1) 2 dB (2) 4 dB (3) 8 dB (4) 15 dB (5) 20 dB (6) 20 dB	(1) 0.15 dB max. (2) 0.35 dB max. (3) 0.75 dB max. (4) 1.5 dB max. (5) 2.5 dB max. (6) 3.5 dB max.
		c. Set the IF ATTENUATOR switch to 0 dB and add 20 dB to the external attenuator.	c. The dB difference is 0.5 dB max.

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
9 (Cont'd)		Record the difference in dB between the attenuation removed from the Panalyzor and the attenuation added to the external attenuator.	
10	To check intermodulation distortions.	Disconnect the signal generator from the SIGNAL INPUT jack. Set the TEST SIGNAL-Hz switch to 3.0 M and 3.002 M, the AMPLITUDE SCALE switch to LOG and IF ATTENUATOR switch to 20 dB, and the FREQ SCALE-Hz/DIV switch 1.4K. Rotate the GAIN control fully CW and set the test oscillator frequency to 3.5 MHz, at a 0.3-volt output level. Tune the test oscillator until the two-tone pips are centered on the screen. Use the ATTENUATOR switches and GAIN control to set the two-tone pips at full-scale. Set the IF ATTENUATOR switch to 0 dB and observe the intermodulation distortion products.	Intermodulation products fall below the -40 DB mark on the CRT (-60 DB below two-tone signal level).

4-12. POWER SUPPLY CHECKS.

4-13. Before proceeding with the systematic troubleshooting of the Panalyzor, the +21 vdc and -11 vdc input voltages from the Main Frame should be checked. This check will usually determine whether abnormal d-c voltages are causing the malfunction. To check these voltages, remove the Panalyzor from the Main Frame and connect d-c power to the module using the supplied service cable. Remove the bottom cover and use the VTVM to measure the +21 vdc supply voltage between P1-15 (positive) and chassis ground; and the -11 vdc supply voltage between P1-7 (negative) and chassis ground.

4-14. SYSTEMATIC TROUBLE LOCALIZATION.

4-15. Three possible troubles are presented in table 4-4 to illustrate a systematic approach to the isolation of trouble within the Panalyzor. This procedure is performed with the Panalyzor connected to the Main Frame via the supplied service cable. Note that full use is made of the maintenance information in the manual (e.g., detailed block diagram, schematic diagrams, and voltage chart). The three possible problems that will be considered are:

a. No trace on CRT.

b. Normal CRT trace, but low noise and signal.

c. Normal CRT trace with normal noise, but no input signal or test signals.

4-16. Before proceeding with the troubleshooting procedure of table 4-4, set the front panel controls on the Panalyzor as indicated below and allow the equipment a 10-minute warmup period.

FREQ SCALE-Hz/DIV switch	VAR
FREQ SCALE control	Fully CW
IF BANDWIDTH control	Fully CW
GAIN control	Fully CW
SWEEP RATE-Hz switch	1.5 - 30
VARIABLE control	Fully CW
TEST SIGNAL-Hz control	OFF

AMPLITUDE SCALE switch	LIN
IF ATTENUATOR switch	20 dB
SWEEP MODE switch	NORMAL
ATTENUATOR switch	All in the OUT position
VIDEO FILTER switch	OFF

4-17. ALIGNMENT PROCEDURE.

4-18. Paragraphs 4-21 through 4-29 give a complete alignment procedure for the Panalyzor. Each of these procedures starts with the operator's controls set as indicated in paragraph 4-20 below so that any procedure can be performed independent of the rest. (If the complete alignment procedure is to be performed, perform the alignment in the sequence indicated.) It should be stressed that these procedures should be performed only when a minimum performance standard check is not satisfactory or a component has been replaced in an adjustable circuit.

4-19. The alignment procedures given are performed with the Panalyzor connected to the Main Frame via the supplied service cable. It is assumed that the Main Frame used is operating within its specifications. Therefore, the minimum performance checks given in the Main Frame instruction manual should be performed prior to starting the alignment of the Panalyzor.

4-20. Before performing the alignment procedure set the front panel controls on the Panalyzor and Main Frame as indicated below and allow the equipment a 10-minute warmup period.

Panalyzor

FREQ SCALE-Hz DIV switch	VAR
FREQ SCALE control	Fully CW
IF BANDWIDTH control	Fully CW
GAIN control	Fully CW
SWEEP RATE-Hz switch	1.5 - 30
VARIABLE control	Fully CW
TEST SIGNAL-Hz control	OFF
CENTER FREQ LEVEL control	Midposition
AMPLITUDE SCALE switch	LIN
IF ATTENUATOR switch	20 dB
VIDEO FILTER switch	OFF
SWEEP MODE switch	NORMAL
ATTENUATOR switches	All in the OUT position

Main Frame

SCALE ILLUMINATION control	Rotated CW until the CRT graticule illuminates
FOCUS control	Adjusted for a sharp trace on the CRT
BRIGHTNESS control	As desired
VERT. POS control	Adjust so that the baseline trace coincides with the frequency scale
HORIZ POS control	Adjust to approximately center the baseline trace on the CRT

4-21. SWEEP RATE ADJUSTMENT. To adjust the sweep rate, proceed as follows:

a. Set the front panel controls on the Panalyzor and Main Frame as indicated in paragraph 4-20.

b. Set the FREQ SCALE-Hz/DIV switch to 1.4K. Using a stop watch, measure the time required for 20 complete sweeps on the CRT.

c. Adjust A6R26 so that the time required for 20 complete sweeps is from 18 to 22 seconds.

d. Set the FREQ SCALE-Hz/DIV switch to 50. Using a stop watch, measure the time required for 2 complete sweeps on the CRT.

e. Adjust A6R24 so that the time required for 2 complete sweeps is from 18 to 22 seconds.

4-22. MARKER FREQUENCY ADJUSTMENT. To adjust the frequency of the 5-kHz marker generator, proceed as follows:

a. Set the front panel controls on the Panalyzor and Main Frame as indicated in paragraph 4-20.

b. Set the TEST SIGNAL-Hz switch to 5K.

TABLE 4-4. SYSTEMATIC TROUBLE LOCALIZATION

No.	Symptom	Test Procedure	If Indication Is Normal	If Indication Is Abnormal
1	No trace on CRT.	a. Check for the presence of sawtooth waveform on pin 7 of J2 with an oscilloscope.	a. Troubleshoot the Main Frame as described in its instruction manual.	a. Go to b.
		b. Check for the presence of a sawtooth waveform on pin 13 of J6 with an oscilloscope.	b. Check SWEEP MODE switch S5.	b. Troubleshoot sawtooth generator A6Q4, A6Q5, and A6Q6.
2	Low noise and signal on CRT. **Note** Almost all the noise generated by the Panalyzor is amplified in the A7 and A8 modules; noise that is generated in the earlier stages receives its largest amplification in these modules. Thus, the problem could be caused by a low gain stage in either of these modules.	a. Rotate the VERT POS control on the Main Frame and observe that the baseline moves. **Note** For steps b through f, it is necessary to slightly rock the frequency of the signal generator to obtain a true baseline rise.	a. Go to b.	a. Troubleshoot the Main Frame as described in its instruction manual.
		b. Connect a 100-kHz, 180 microvolt signal to pin 1 of J7. Observe that the CRT baseline rises to approximately full scale.	b. Go to c.	b. Troubleshoot the A7 module.
		c. Connect a 100-kHz, 3 millivolt signal to pin 14 of J8. Observe that the CRT baseline rises to approximately full scale.	c. Go to d.	c. Troubleshoot the A8 module.
		d. Connect a 500-kHz, 3 millivolt signal to pin 15 of J3. Observe that approximately a full-scale signal pip is obtained on the CRT.	d. Go to e.	d. Troubleshoot the balanced mixer portion of the A3 module.

(Cont'd)

TABLE 4-4. SYSTEMATIC TROUBLE LOCALIZATION (Cont'd)

No.	Symptom	Test Procedure	If Indication Is Normal	If Indication Is Abnormal
2 (Cont'd)		e. Connect a 500-kHz, 120 microvolt signal to pin 5 of J5. Observe that approximately a full-scale signal pip is obtained on the CRT.	e. Go to f.	e. Troubleshoot the A4 module. Also check GAIN control R1.
		f. Connect a 500-kHz, 100 microvolt signal to terminal E1 on the A9 module. Observe that approximately a full-scale pip is obtained on the CRT. **Note** Wide variations in sensitivity may be experienced at this point. A range of 50 to 400 microvolts (if no VFO input is present) is not to be considered abnormal.	f. Check input attenuator A10.	f. Troubleshoot the A9 module.
3	Normal noise on CRT, but no input signal or test signals. **Note** The fact that the CRT trace and noise are normal indicates that the sawtooth generator and A7 and A8 modules are functioning properly. Thus, the defective component must be in or before the balanced mixer.	a. Set the FREQ SCALE control fully CCW. Check for the presence of a 6-volt, peak-to-peak 600 kHz square wave at pin 8 or 10 of J3 with an oscilloscope (through a high impedance probe).	a. Go to b.	a. Go to e.

(Cont'd)

TABLE 4-4. SYSTEMATIC TROUBLE LOCALIZATION (Cont'd)

No.	Symptom	Test Procedure	If Indication Is Normal	If Indication Is Abnormal
3 (Cont'd)		b. Set the FREQ SCALE control fully CW. Inject a 500-kHz signal into pin 15 of J3, and check for a signal pip on the CRT.	b. Go to c.	b. Troubleshoot the balanced mixer portion of the A3 module.
		c. Inject the 500-kHz signal into pin 5 of J5, and check for a signal pip on the CRT.	c. Go to d.	c. Troubleshoot the A5 module.
		d. Inject a 500-kHz signal into terminal E1 of A9 module, and check for a signal pip on the CRT.	d. Troubleshoot the input attenuator A10.	d. Troubleshoot the A9 module.
		e. Set the FREQ SCALE control fully CW and check for the presence of a sawtooth waveform at pin 5 of J2 with an oscilloscope (through a high impedance probe).	e. Troubleshoot unity-gain amplifier A2Q3 through A2Q6 and multivibrator A2Q1/Q2.	e. Troubleshoot emitter followers A2Q7 and A2Q8, and associated circuitry.

c. Connect a frequency counter to pin 11 of connector J4.

d. Adjust A4R16 until the counter indicates 5 kHz.

4-23. SWEEP LINEARITY ADJUSTMENT. To perform the sweep linearity adjustment, proceed as follows:

a. Set the front panel controls on the Panalyzor and Main Frame as indicated in paragraph 4-20.

b. Connect an oscilloscope to pin 12 of plug P1 and observe the sawtooth waveform.

c. Adjust A6R20 for best linearity of the sawtooth waveform.

4-24. DC BALANCE ADJUSTMENT. To perform the d-c balance adjustment, proceed as follows:

a. Set the front panel controls on the Panalyzor and Main Frame as indicated in paragraph 4-20.

b. Set the TEST SIGNAL-Hz switch to CF and rotate the CENTER FREQ LEVEL control to provide an approximately full-scale pip.

c. Rotate the FREQ SCALE control maximum CCW and adjust the CENTER FREQ 2 COARSE control for a maximum baseline rise.

d. Rotate the FREQ SCALE control fully CW.

e. Adjust A2R18 until the signal pip is under the CF line engraved on the CRT graticule.

4-25. 100-kHz CRYSTAL FILTER ADJUSTMENT. To perform the 100-kHz crystal filter adjustment, proceed as follows:

a. Set the front panel controls on the Panalyzor and Main Frame as indicated in paragraph 4-20.

b. Set the TEST SIGNAL-Hz switch to CF and adjust the CENTER FREQ LEVEL control until approximately a full-scale signal pip is obtained on the CRT.

c. Adjust the CENTER FREQ 2 COARSE control to center the pip on the CRT.

d. Remove crystal A8Y3 from its socket. Rotate core in A8T1 completely counterclockwise. Adjust CENTER FREQ LEVEL control to obtain a full-scale pip.

e. Rotate the FREQ SCALE control so that the display occupies approximately one half of the base line.

f. Adjust capacitor A8C4 for most symmetrical pip skirts.

g. Adjust A8T1 for maximum bandwidth. Adjustment of A8T1 in the correct direction will cause the signal pip to reduce in amplitude. The point of maximum bandwidth is when the signal pip goes thru an amplitude null. If the pip does not go thru a null, the value of factory selected capacitor A8C6 should be changed.

Note

If the core of transformer A8T1 is fully withdrawn, and an amplitude null cannot be achieved, reduce the value of A8C6 to the next lower standard value. Conversely, if the core of A8T1 is fully inserted, increase the value of A8C6 to the next higher value.

h. Remove crystal A8Y2. Readjust CENTER FREQ LEVEL control to obtain a full-scale pip. Rotate the FREQ SCALE control so that the display occupies approximately one-half of the baseline. Adjust A8C4 for best symmetry of the pip.

i. Adjust A8T1 for maximum bandwidth.

j. Plug in crystal A8Y2. Rotate core in A8T3 completely counterclockwise. Adjust CENTER FREQ LEVEL control to obtain a full-scale pip. Rotate the FREQ SCALE control so that the display occupies approximately one-half of the baseline.

k. Repeat steps f. and g. adjusting A8C14 and A8T3 instead of A8C4 and A8T1. If the pip does not go thru a null, the value of factory selected capacitor A8C16 should be changed.

Note

If the core of transformer A8T3 is fully withdrawn, and an amplitude null cannot be achieved, reduce the value of A8C16 to the next lower standard value. Conversely, if the core of A8T3 is fully inserted, increase the value of A8C16 to the next higher value.

l. Remove crystal A8Y1. Repeat steps h. and i. adjusting A8T3 and A8C14 instead of A8C4 and A8T1.

m. Plug in crystal A8Y3. Rotate core in A8T5 completely counterclockwise. Adjust CENTER FREQ LEVEL control to obtain a full-scale pip. Rotate the FREQ SCALE control so that the display occupies approximately one-half of the baseline.

n. Repeat steps f. and g. adjusting A8C21 and A8T5 instead of A8C4 and A8T1. If the pip does not go thru a null, the value of factory selected capacitor A8C23 should be changed.

Note

If the core of transformer A8T5 is fully withdrawn, and an amplitude null cannot be achieved, reduce the value of A8C23 to the next lower standard value. Conversely, if the core of A8T5 is fully inserted, increase the value of A8C23.

o. Remove crystal A8Y2. Repeat steps h. and i. adjusting A8C21 and A8T5 instead of A8C4 and A8T1.

p. Plug in crystals A8Y1 and A8Y2. Readjust A8C4 and A8C21, as necessary, for best symmetry of the signal pip. Readjust A8T1 and A8T5, as necessary, for maximum bandwidth.

4-26. LOG/LIN AMPLITUDE ADJUSTMENT. To perform the log/lin amplitude adjustment, proceed as follows:

a. Set the front panel controls on the Panalyzor and Main Frame as indicated in paragraph 4-20.

b. Insert 40 dB of attenuation at the input of the Panalyzor by setting the two 20 dB ATTENUATOR switches to their IN position.

c. Set the AMPLITUDE SCALE switch to LOG, and the TEST SIGNAL-Hz switch to CF. Set CENTER FREQ LEVEL for a half scale pip.

d. Adjust A7R49 fully CCW and then adjust it approximately 1/4-turn in the CW direction.

e. Adjust A7R59 and A7R61 to their midposition.

f. Rotate the IF BANDWIDTH control until best symmetry of the signal pip is obtained on the CRT.

g. Adjust the CENTER FREQ LEVEL control so that the signal pip amplitude is -40 dB.

h. Remove the 40 dB of attenuation inserted in step b at the Panalyzor input.

i. Adjust A7R59 so that the amplitude of the signal pip is 0 dB.

j. Insert 40 dB of attenuation at the Panalyzor input and adjust the CENTER FREQ LEVEL control so that the signal pip amplitude is -40 dB.

k. Remove 40 dB of attenuation from the Panalyzor input and observe the pip height. If it is not 0 dB, readjust A7R59.

l. Repeat steps j and k until the signal pip amplitude is -40 dB with 40 dB of attenuation inserted at the Panalyzor input and 0 dB when the 40 dB of attenuation is removed from the Panalyzor input.

m. Insert 20 dB of attenuation (total) at the Panalyzor input. A signal pip amplitude of -20 dB should be obtained on the CRT. If not, note how much the pip amplitude is above or below -20 dB.

n. Insert a total of 40 dB of attenuation at the Panalyzor input. Adjust A7R49 to increase or decrease the pip height by the amount noted in step n (e.g., if the pip amplitude noted in step m was -18 dB, increase the pip height by 2 dB).

o. Repeat steps g through n.

p. Adjust the CENTER FREQ LEVEL control so that the signal pip amplitude is -20 dB.

q. Set the AMPLITUDE SCALE switch to LIN and observe that a full-scale pip is obtained on the CRT. If not, adjust A7R61 for exactly a full-scale pip.

r. Adjust A7L1 for a peak indication on the CRT.

4-27. PRESET AND VARIABLE SWEEP WIDTHS ADJUSTMENT. To perform the preset and variable sweep widths adjustment, proceed as follows:

a. Set the front panel control on the Panalyzor and Main Frame as indicated in paragraph 4-20.

b. Set the AMPLITUDE SCALE switch to LOG, and the TEST SIGNAL-Hz switch to CF. Adjust the CENTER FREQ LEVEL control to obtain a full-scale signal pip on the CRT.

c. Adjust the CENTER FREQ 2 COARSE control to place the signal pip under the CF line.

d. Reduce the sweep rate slightly, using the SWEEP RATE control.

e. Connect the test oscillator to the EXT CF MOD jack. Set the test oscillator frequency to 25 kHz. Adjust the output level of the test oscillator until sideband pips appear on the CRT; then set the test oscillator frequency to 50 kHz.

f. Adjust A5R19 until the sideband pips are located exactly on the calibrated screen limits. Readjust the CENTER FREQ 2 COARSE control, as necessary, to obtain this result.

g. Set the FREQ SCALE-Hz/DIV switch to 1.4K and set the test oscillator frequency to 7 kHz.

h. Repeat procedure in step f, adjusting A5R18 instead of A5R19.

i. Set the FREQ SCALE-Hz/DIV switch to 50 and the SWEEP MODE switch to MANUAL.

j. Adjust the MANUAL SWEEP control until the dot appears under the CF line.

k. Rotate the CENTER FREQ 1 control fully CCW, and then rotate it 1/2 turn in the CW direction.

l. Connect a frequency counter to pin 3 of connector J6.

m. Adjust A6L1 until the counter indicates 600 kHz. Disconnect the counter at the conclusion of this step.

n. Set the SWEEP MODE switch to NORMAL and the test oscillator frequency to 250 Hz. Adjust the CENTER FREQ LEVEL control until a full-scale pip is obtained on the CRT.

o. Center the pip under the CF line, using the CENTER FREQ 1 control. (This procedure is

simplified by setting the SWEEP MODE switch to MANUAL and using the MANUAL SWEEP control to place the dot in the center of the CRT frequency scale. Slowly adjust the CENTER FREQ 1 control until the dot rises to a maximum. Then return the SWEEP MODE switch to NORMAL and make any necessary readjustments of the CENTER FREQ 1 control to center the pip.)

p. Adjust A2R22 until the sideband pips are located exactly on the calibrated screen limits. Readjust the CENTER FREQ 1 control, as necessary, to obtain this result.

q. Adjust A6R3 for best frequency linearity of the CF pip and sideband pips. That is, the CF pip will be within one half division of the CF screen calibration when the sideband pips are exactly on the screen calibration limits.

r. Repeat steps p and q for optimum results.

s. Set the FREQ SCALE-Hz/DIV switch to 15 and the test oscillator frequency to 75 Hz. Adjust the CENTER FREQ LEVEL control until a full-scale pip is obtained on the CRT.

t. Repeat step o.

u. Repeat step p, adjusting A2R21 instead of A2R22.

4-28. IF GAIN AND BANDWIDTH ADJUSTMENT. To perform the i-f gain and bandwidth adjustment, proceed as follows:

a. Set the front panel controls on the Panalyzor and Main Frame as indicated in paragraph 4-20.

b. Connect the test oscillator to the VFO INPUT jack and the signal generator to the SIGNAL INPUT jack. Set the test oscillator frequency to 3.5 MHz, at a 0.3-volt output level. Set the signal generator frequency to 3.0 MHz, at a 150-microvolt output level.

c. Adjust the signal generator frequency slightly until the signal pip appears under the CF line.

d. Adjust A5R14 fully CW. Adjust A1R6 for a full-scale signal pip on the CRT.

e. Adjust A5R14 until the pip amplitude drops 1 division (1 dB) on the LIN scale.

f. Set the FREQ SCALE-Hz/DIV switch to 1.4K, the AMPLITUDE SCALE switch to LOG, and the IF ATTENUATOR switch to 0 dB.

g. Carefully adjust A1R11 for the narrowest pip without excessive loss in gain. Ringing may appear on the left side of the pip at or near the proper setting of A1R11.

Note

As A1R11 is rotated in a clockwise direction the pip at first will appear broad with greater amplitude. As the control is rotated, the pip becomes narrow and its amplitude decreases. In the 1.4K, 700 and 350 positions of the FREQ SCALE-Hz/DIV switch, after passing point of narrowest pip, the pip will again become broad, and its amplitude will decrease rapidly. In the 50 and 15 position of the FREQ SCALE-Hz/DIV switch, the pip will again become broad and amplitude will increase.

h. Adjust A1R5 for a full-scale signal pip on the CRT.

i. Set the FREQ SCALE-Hz/DIV switch to 700. Repeat steps g and h, using A1R10 and A1R4 instead of A1R11 and A1R5.

j. Set the FREQ SCALE-Hz/DIV switch to 350. Repeat steps g and h, using A1R9 and A1R3 instead of A1R11 and A1R5.

k. Set the FREQ SCALE-Hz/DIV switch to 50. Center the signal pip, using the CENTER FREQ 1 control. (This procedure is simplified by setting the SWEEP MODE switch to MANUAL and the MANUAL SWEEP control to place the dot in the center of the CRT frequency scale. Slowly adjust the CENTER FREQ 1 control until the dot rises to a maximum. Then return the SWEEP MODE switch to NORMAL and make any necessary readjustments of the CENTER FREQ 1 control to center the pip.)

l. Repeat steps g and h, using A1R8 and A1R2 instead of A1R11 and A1R5. (Momentarily set the SWEEP MODE switch to FAST to quickly obtain the signal pip at the center of the screen.)

m. Set the FREQ SCALE-Hz/DIV switch to 15 and repeat steps g and h, using A1R7 and A1R1 instead of A1R11 and A1R5.

n. Set the FREQ SCALE-Hz/DIV switch to 1.4K, the AMPLITUDE SCALE switch to LIN, and the IF ATTENUATOR switch to 20 dB. Readjust A1R5, if necessary, to obtain a full-scale signal pip on the CRT.

o. Set the FREQ SCALE-Hz/DIV switch to 700 and readjust A1R4, if necessary, to obtain a full-scale signal pip on the CRT.

p. Set the FREQ SCALE-Hz/ DIV switch to 350 and readjust A1R3, if necessary, to obtain a full-scale signal pip on the CRT.

q. Set the FREQ SCALE-Hz/DIV switch to 50 and readjust A1R22, if necessary, to obtain a full-scale signal pip on the CRT.

r. Set the FREQ SCALE-Hz/DIV switch to 15 and readjust A1R1, if necessary, to obtain a full-scale signal pip on the CRT.

4-29. TWO-TONE TEST BALANCE ADJUSTMENT. To perform the two-tone test balance adjustment, proceed as follows:

a. Set the front panel controls on the Panalyzor and Main Frame as indicated in paragraph 4-20.

b. Connect the test oscillator to the VFO INPUT jack. Set the test oscillator frequency to 3.5 MHz, at an output level of 0.3 volts.

c. Set the FREQ SCALE-Hz/DIV switch to 1.4K and the TEST SIGNAL-Hz switch to 3.0 M and 3.002 M. Adjust the GAIN control so that the highest pip is approximately full-scale in the CRT.

d. Adjust A3R15 until the pips of the two-tone display are of equal amplitude.

4-30. TYPICAL VOLTAGE MEASUREMENTS.

4-31. Voltage measurements for each of the transistor stages in the Panalyzor are given in table 4-5. These voltages were obtained by setting the front panel controls at the positions given below and measuring the voltages with an RCA Model WV-98C VTVM.

Control	Position
VIDEO FILTER switch	OFF
AMPLITUDE SCALE switch	LIN
IF ATTENUATOR switch	20 dB
TEST SIGNAL-Hz control	OFF
CENTER FREQ LEVEL control	Fully CCW
FREQ SCALE control	Fully CW
IF BANDWIDTH control	Fully CW
SWEEP RATE-Hz switch	1.5 - 30
VARIABLE control	Fully CW
SWEEP MODE switch	NORMAL
GAIN control	Fully CW
CENTER FREQ 2 control	Midposition
FREQ SCALE-Hz/DIV switch	VAR
ATTENUATOR switches	All in the OUT position

TABLE 4-5. VOLTAGE MEASUREMENTS

Module	Stage	Emitter	Base	Collector
A2	Q1	-10.5	-11.0	- 7.8
	Q2	-10.5	-10.8	- 7.5
	Q3	- 3.2	- 3.7	-10.8
	Q4	-10.8	-10.2	- 3.7
	Q5	- 2.5	- 3.1	-10.8
	Q6	- 2.5	- 2.8	-10.2
	Q7	0	+ 0.6	+21.0
	Q8	- 5.6	- 6.4	-10.8
A3 (See Note 1)	Q1	- 7.0	- 7.4	-10.4
	Q2	- 7.0	- 7.6	-10.4
	Q3	+16.0	+15.0	+ 7.5
	Q4	+16.5	+16.0	+ 7.0

(Cont'd)

SECTION V
SCHEMATIC DIAGRAMS

TABLE 4-5. VOLTAGE MEASUREMENTS (Cont'd)

Module	Stage	Emitter	Base	Collector
A4 (See Note 2)	Q1	0	-	- 2.2
	Q2	0	+ 2.7	- 2.2
	Q3	- 0.50	- 0.60	- 2.2
	Q4	- 5.4	- 6.0	- 7.4
	Q5	+13.0	+12.6	+ 7.8
	Q6	+ 7.8	+ 7.2	+ 0.58
A5	Q1	- 4.5	- 5.1	- 9.4
	Q2	+ 1.4	+ 2.0	+ 4.1
	Q3	+ 3.5	+ 4.1	+ 9.1
	Q4	+ 8.6	+ 9.1	+15.5
A6	Q1 (See Note 3)	-10.2	- 9.6	- 6.6
	Q2 (See Note 3)	- 0.9	- 1.5	- 4.8
	Q3 (See Note 3)	- 4.5	- 3.8	-10.8
	Q4	+ 4.0	+ 4.5	+20.5
	Q5	+21.0	+20.5	+ 4.5
	Q6	+ 4.5	+11.5	-
A7	Q1	-10.0	- 9.4	0
	Q2	-10.0	- 9.4	0
	Q3	- 8.8	- 8.2	- 6.4
	Q4	- 8.8	- 8.2	- 5.8
	Q5 (See Note 4)	- 8.8	- 8.2	- 5.5
	Q6	- 8.9	- 8.3	+19.0
	Q6 (See Note 4)	+21.0	+21.0	+21.0
	Q7 (See Note 4)	- 9.0	- 8.2	- 5.2
	Q8 (See Note 4)	- 8.7	- 8.0	- 6.0
	Q9 (See Note 4)	- 8.7	- 8.0	- 3.2
	Q10	- 0.5	+ 0.04	+18.5
	Q11	- 0.5	0	+21.0
	Q12	+21.0	+20.5	+ 0.7
	Q13	+ 0.1	+ 0.7	+20.5
A8	Q1	- 2.5	- 3.1	- 6.3
	Q2	- 2.5	- 3.1	- 6.4
	Q3	+ 6.1	+ 5.6	+ 2.6
	Q4	+ 7.0	+ 6.2	+ 2.6
	Q5	+10.0	+ 9.3	+ 6.8
	Q6	- 0.8	- 1.4	- 8.6
	Q7	- 8.0	- 8.6	-10.4
	Q8	- 7.4	- 8.0	- 8.5
	Q9	- 3.8	- 4.5	- 7.4
	Q10	+ 6.0	+ 5.4	+ 2.6
	Q11	+ 6.8	+ 6.0	+ 2.6
	Q12	+10.2	+ 9.4	+ 6.7
	Q13	+ 6.0	+ 5.5	+ 2.6
	Q14	+ 6.8	+ 6.2	+ 2.6
	Q15	+10.0	+ 9.4	+ 6.8
A9	Q1	0	- 0.2	- 7.3

Note

1. TEST SIGNAL-Hz control set to 3.0M and 3.002M.
2. TEST SIGNAL-Hz control set to 5K.
3. FREQ SCALE-Hz/DIV control set to 50.
4. AMPLITUDE SCALE switch set to LOG.

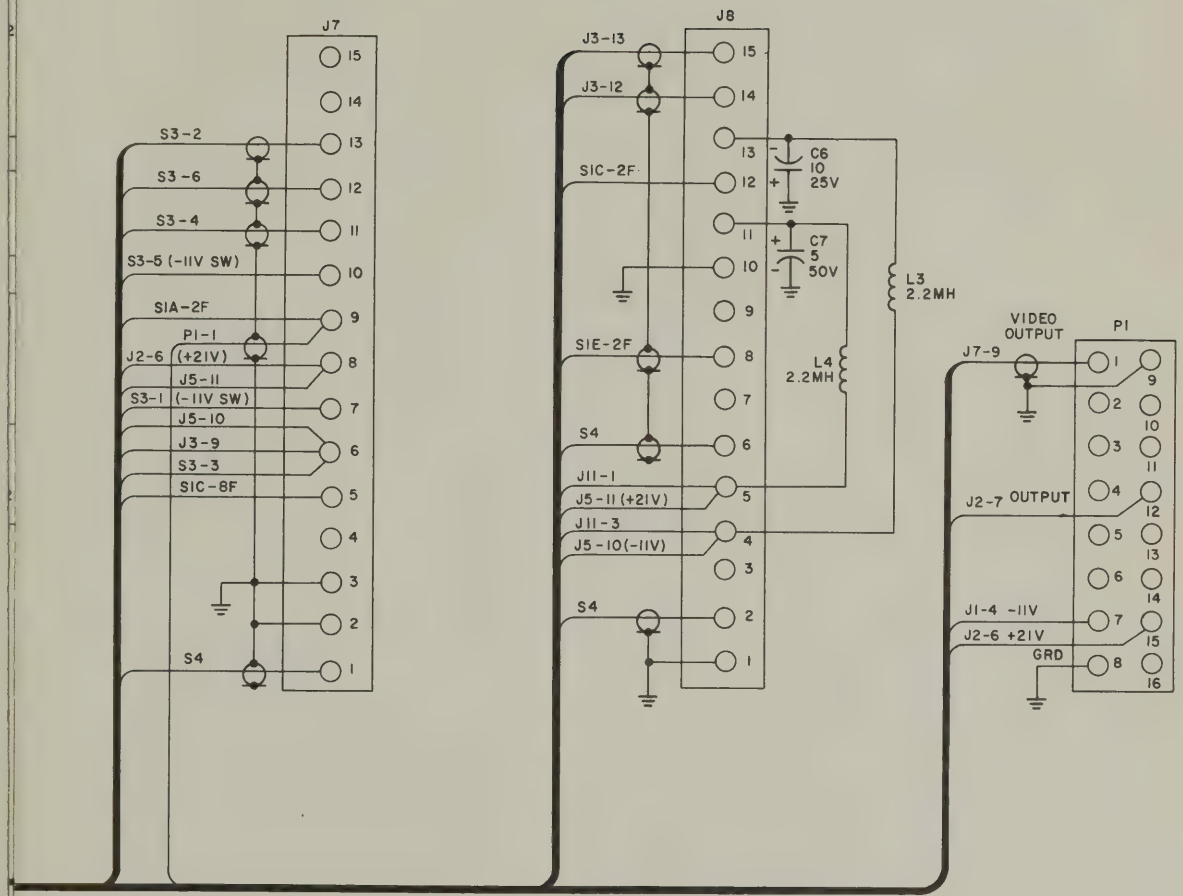
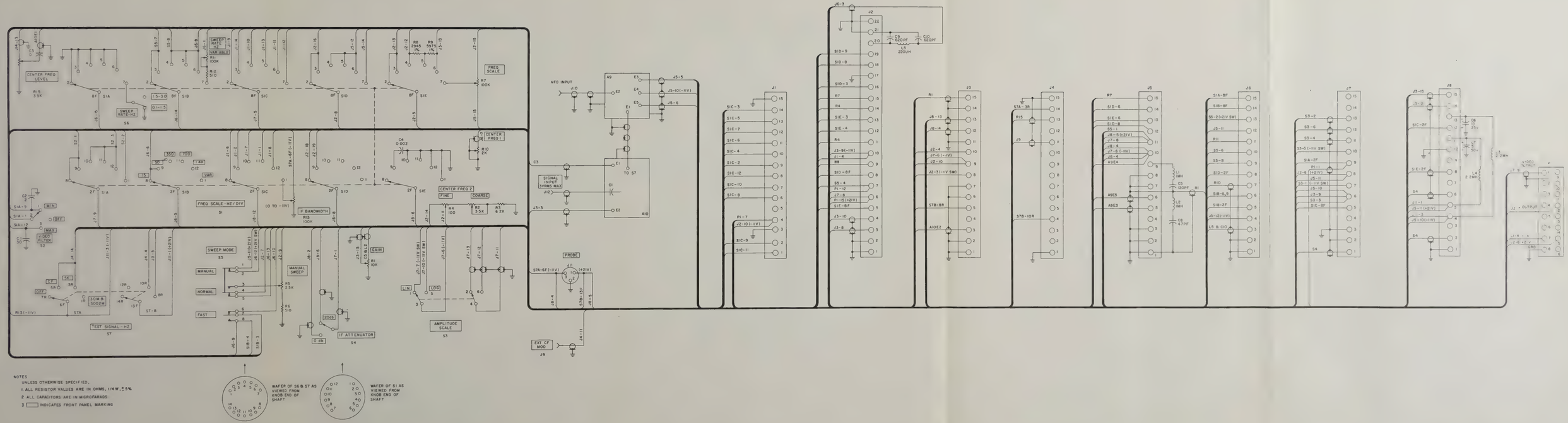


Figure 5-1. Panalyzor, Schematic of Interconnection



NOTES
UNLESS OTHERWISE SPECIFIED.
1. ALL RESISTOR VALUES ARE IN OHMS, 1/4 W, ±5%
2. ALL CAPACITORS ARE IN MICROFARADS
3. ▭ INDICATES FRONT PANEL MARKING

WAFER OF S6 & S7 AS VIEWED FROM KNOB END OF SHAFT

WAFER OF S1 AS VIEWED FROM KNOB END OF SHAFT

Figure 5-1. Panalyzor, Schematic of Interconnection

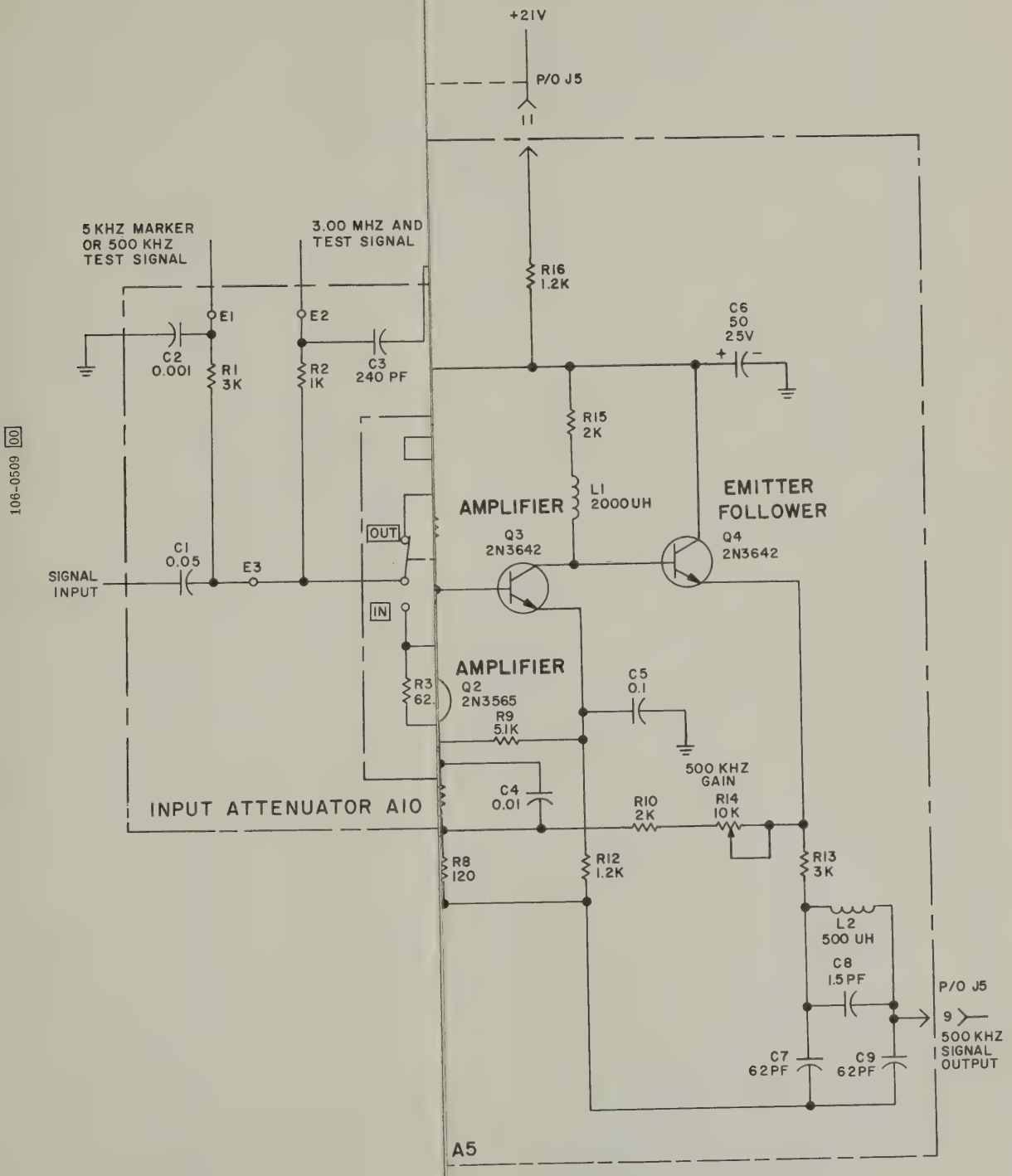


Figure 5-2. Input Attenuator Assembly A10, First Mixer Assembly A9, and 500-kHz I-F Amplifier Assembly A5, Schematic Diagram

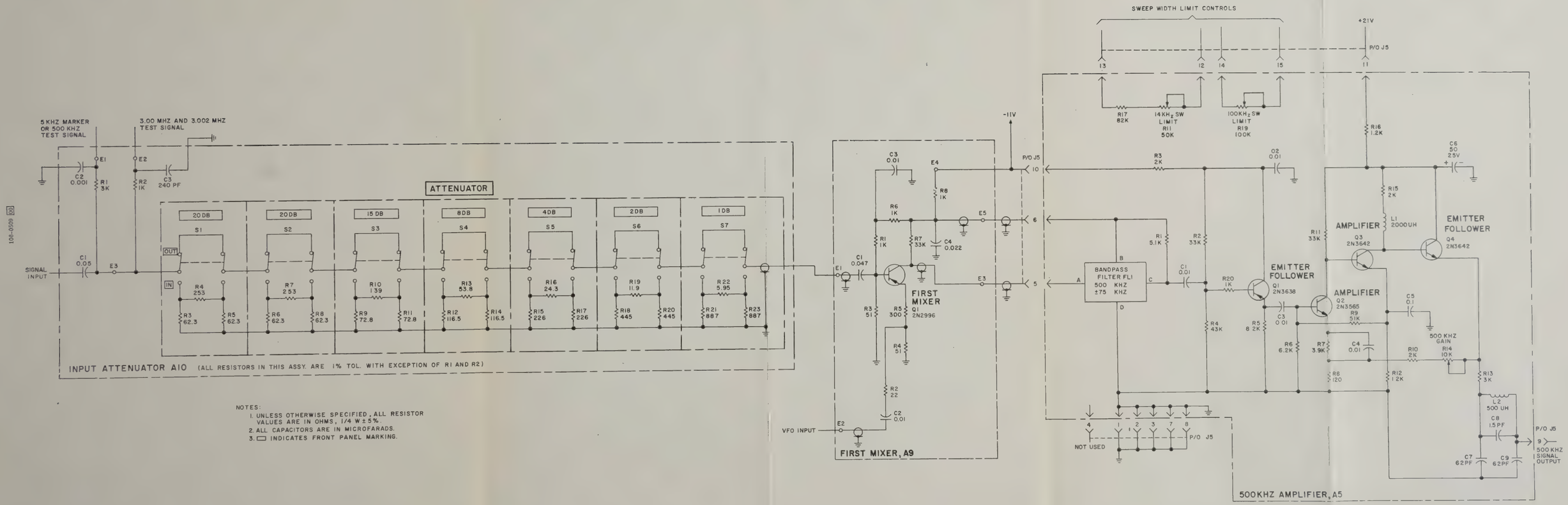
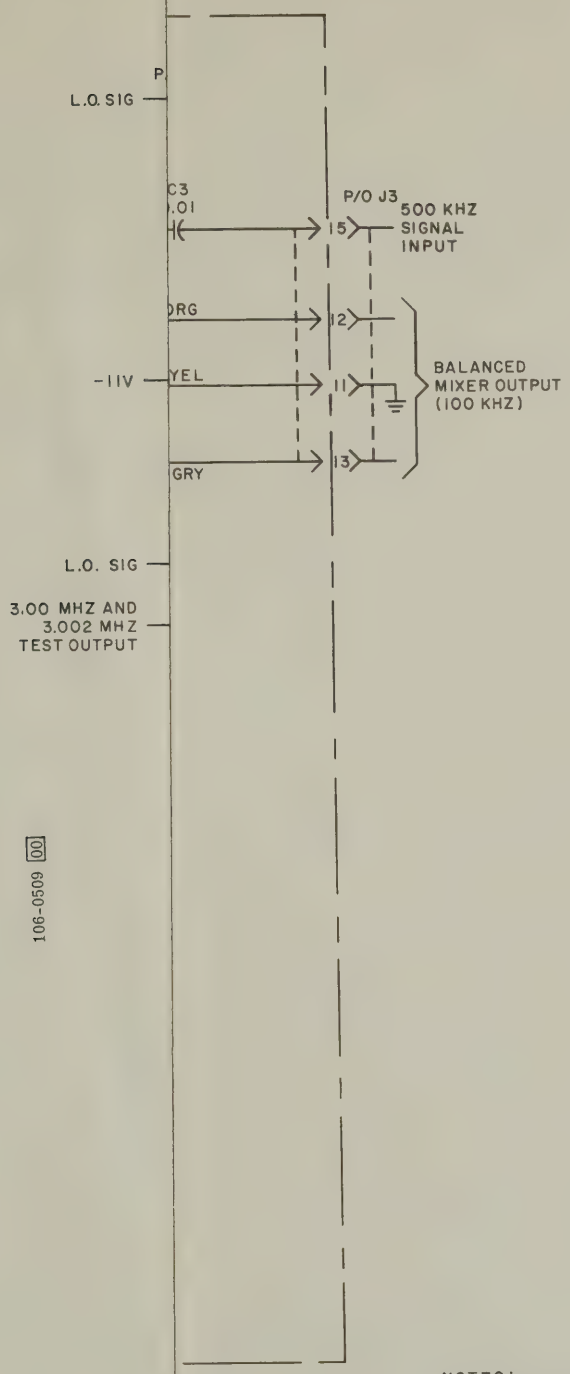
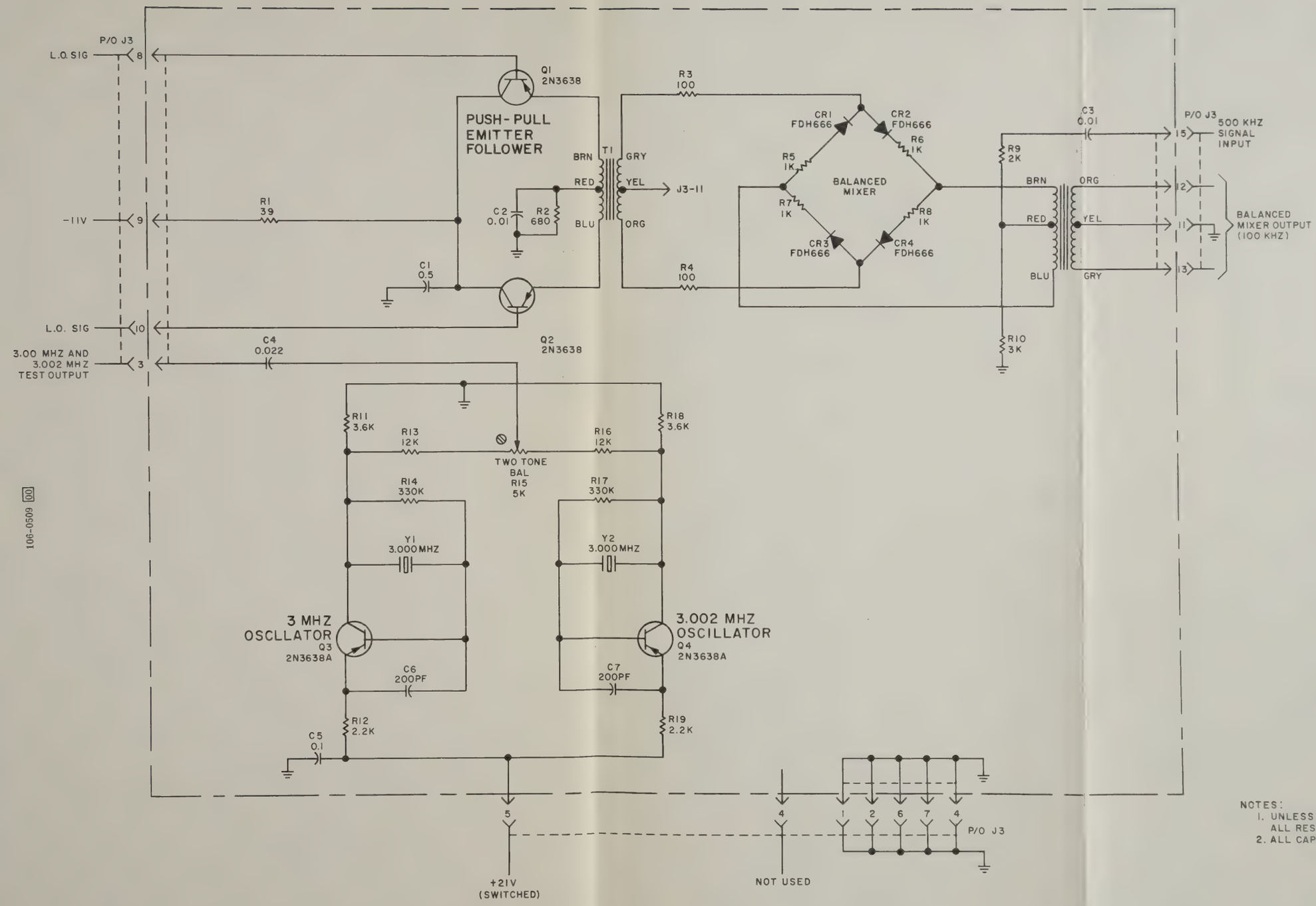


Figure 5-2. Input Attenuator Assembly A10, First Mixer Assembly A9, and 500-kHz I-F Amplifier Assembly A5, Schematic Diagram



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS, 1/4W, ±5%.
2. ALL CAPACITORS ARE IN MICROFARADS.

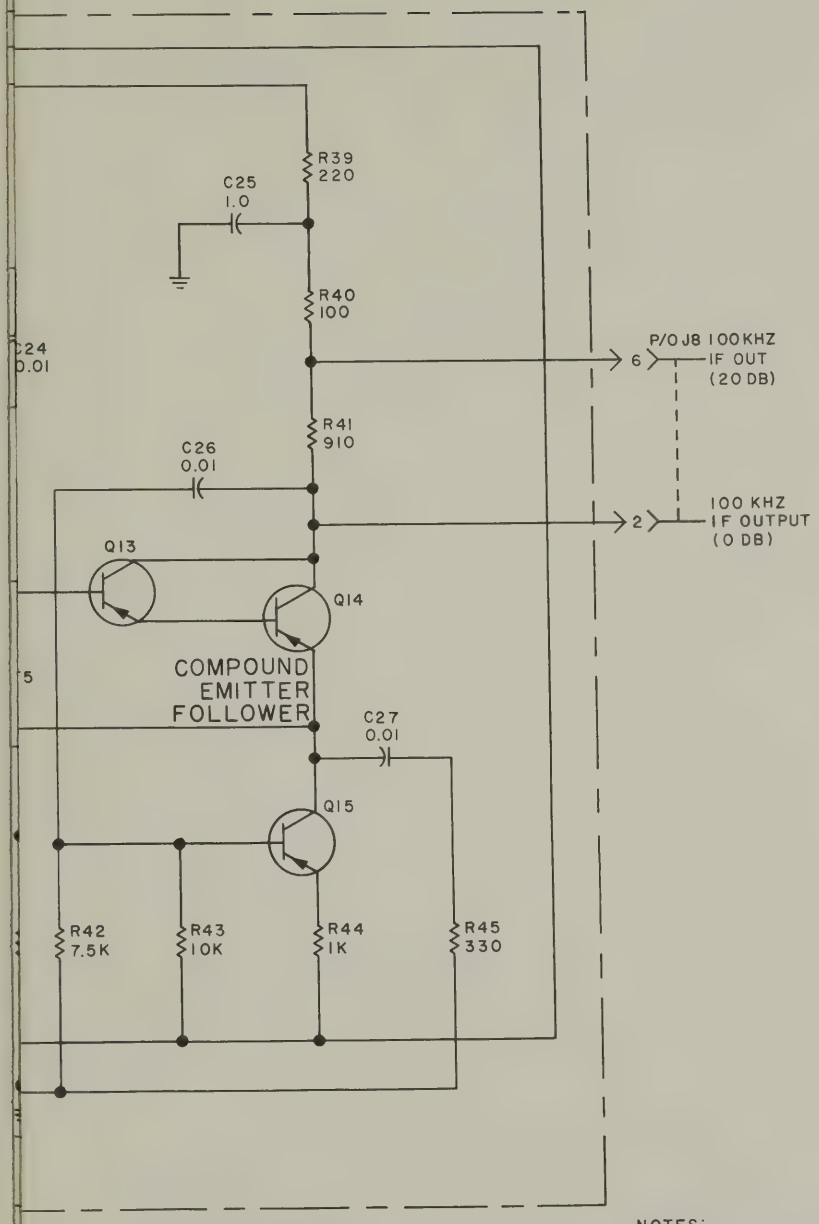
Figure 5-3. Two-tone Generator and 2nd Mixer Assembly A3, Schematic Diagram



106-0509 00

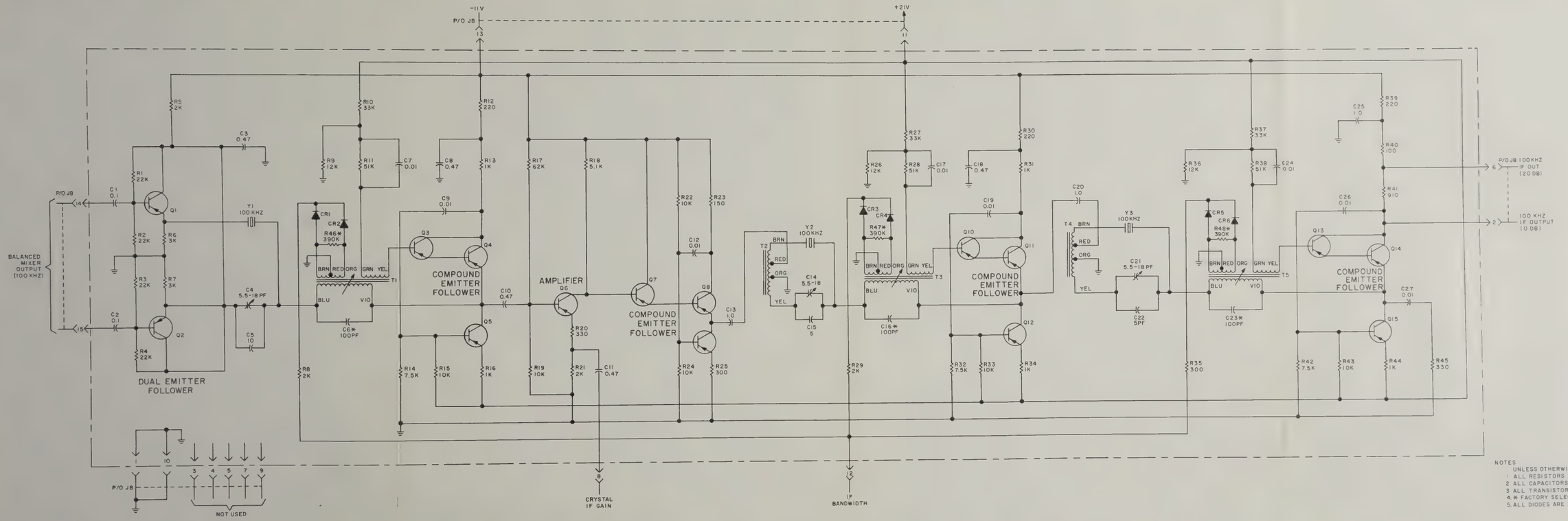
NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS, 1/4W, ±5%.
2. ALL CAPACITORS ARE IN MICROFARADS.

Figure 5-3. Two-tone Generator and 2nd Mixer Assembly A3, Schematic Diagram



NOTES:
UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, 1/4W, ±5%.
2. ALL CAPACITORS ARE MICROFARADS.
3. ALL TRANSISTORS ARE TYPE 2N3638.
4. * FACTORY SELECTED VALUE (NOMINAL VALUE SHOWN).
5. ALL DIODES ARE TYPE 1N251.

Figure 5-4. 100-kHz Crystal I-F Amplifier Assembly A8, Schematic Diagram



NOTES
UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE IN OHMS, 1/4W, ±5%.
2. ALL CAPACITORS ARE MICROFARADS.
3. ALL TRANSISTORS ARE TYPE 2N3638.
4. * FACTORY SELECTED VALUE (NOMINAL VALUE SHOWN).
5. ALL DIODES ARE TYPE 1N251.

Figure 5-4. 100-kHz Crystal I-F Amplifier Assembly A8, Schematic Diagram

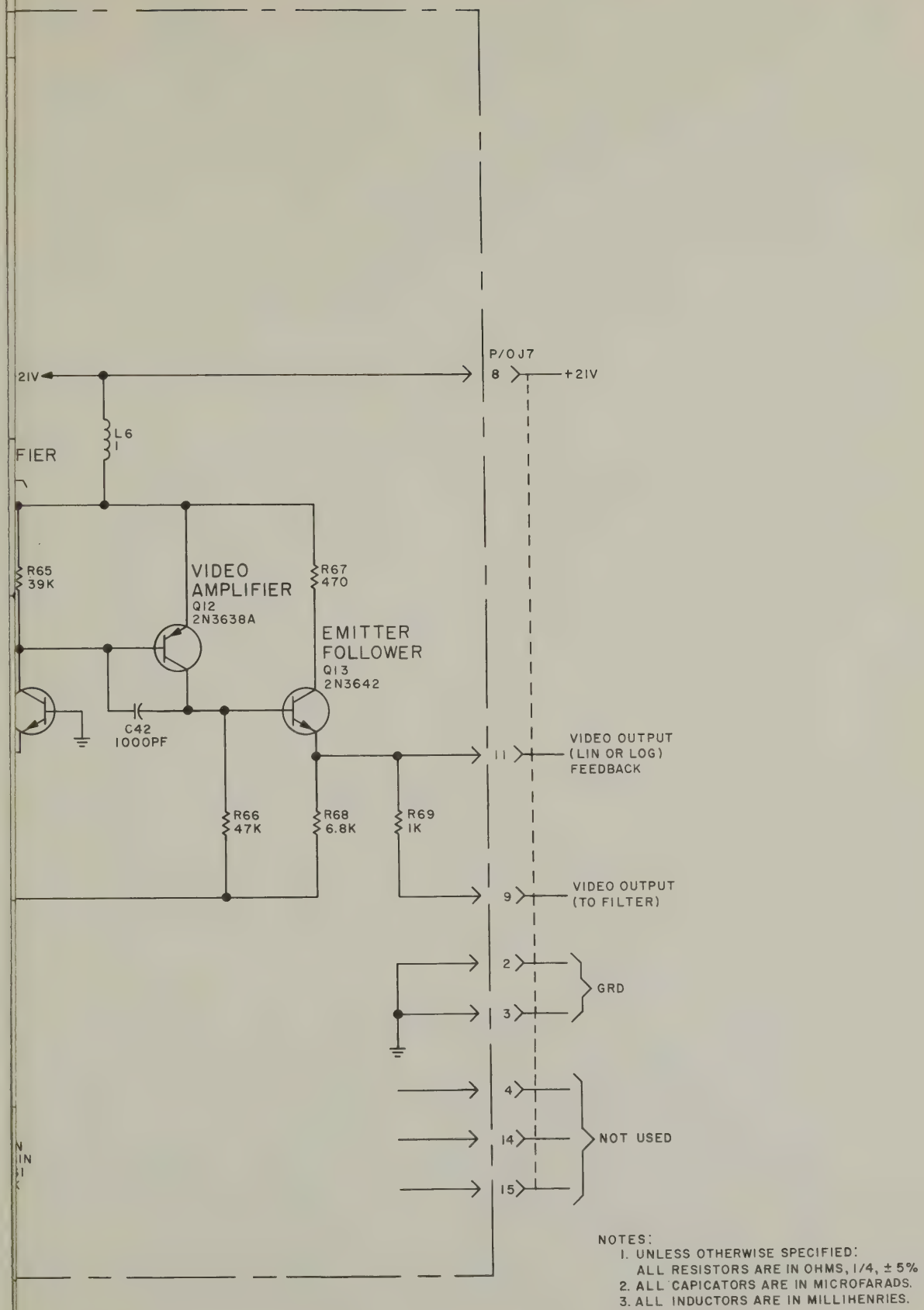


Figure 5-5. Log/Lin Amplifier Assembly A7, Schematic Diagram

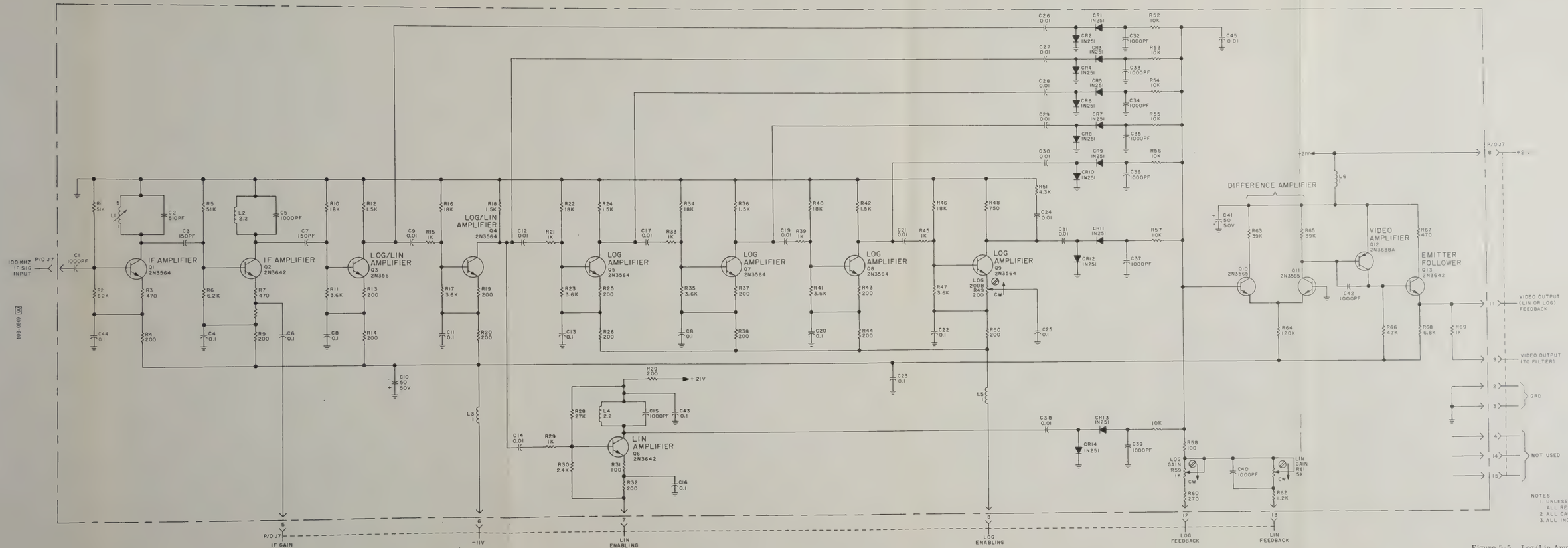


Figure 5-5. Log/Lin Amplifier Assembly A7, Schematic Diagram

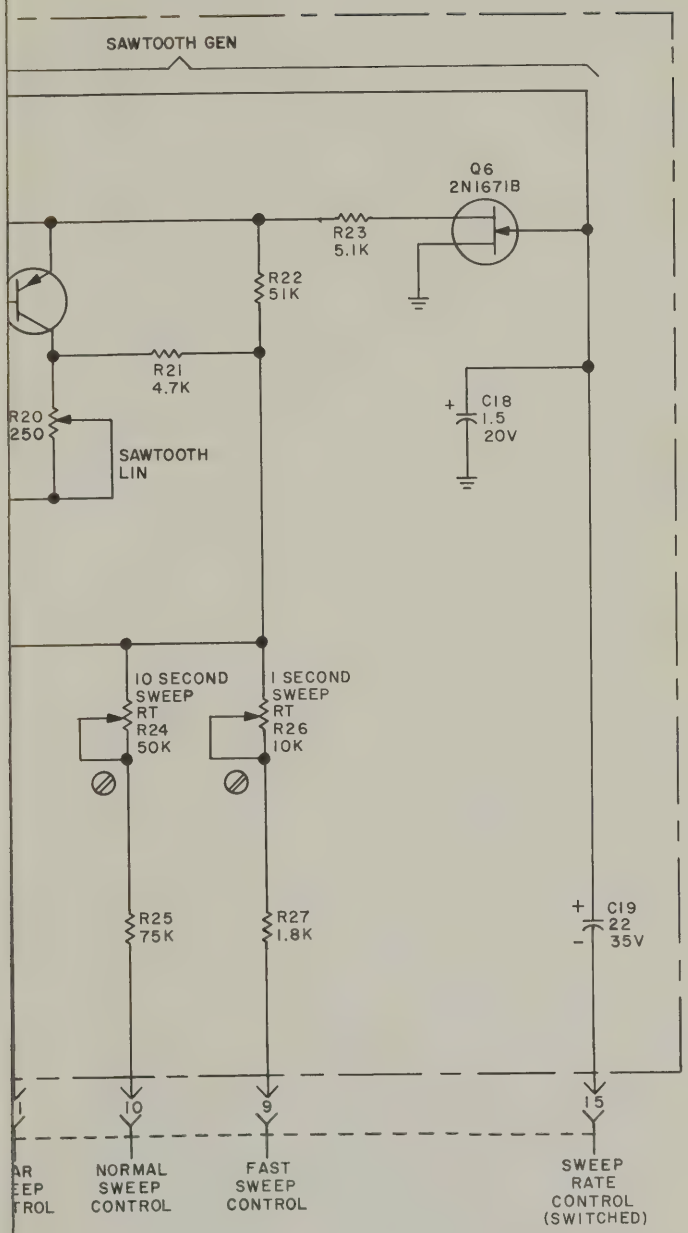
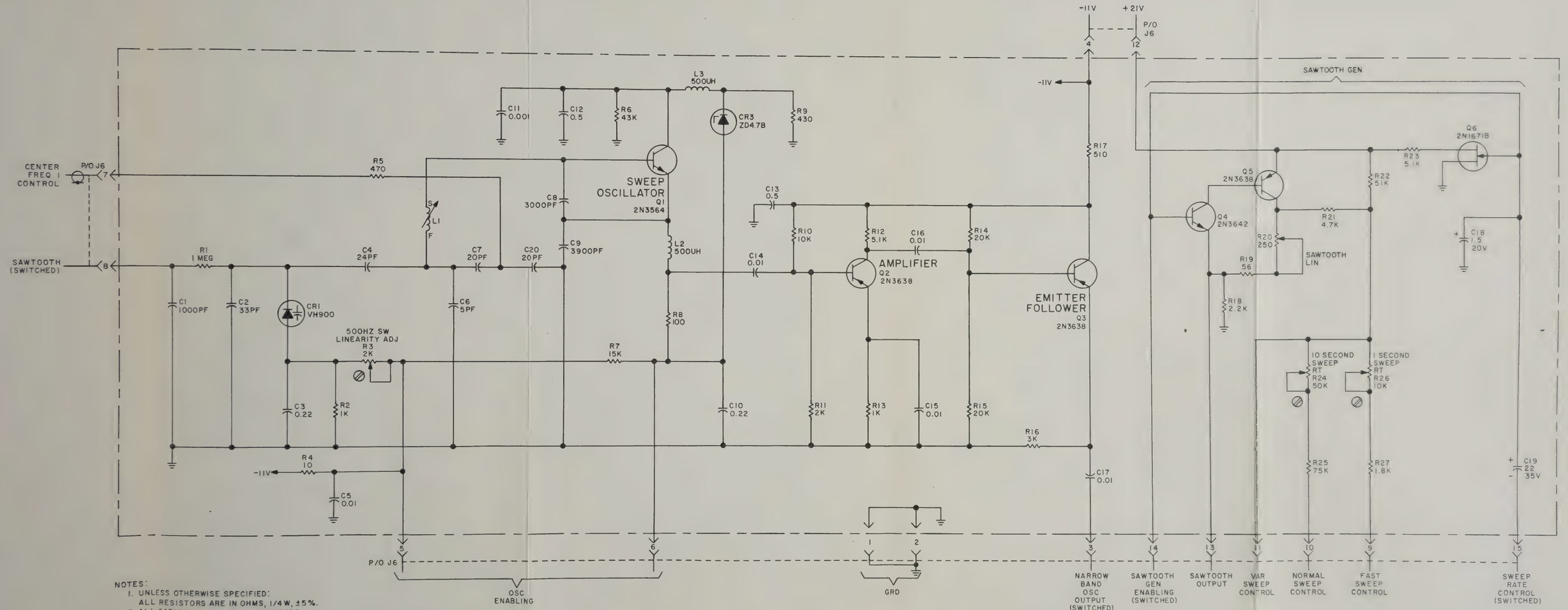


Figure 5-6. Narrow Band Oscillator and Sawtooth Generator Assembly A6, Schematic Diagram



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS, 1/4W, ±5%.
2. ALL CAPACITORS ARE IN MICROFARADS.

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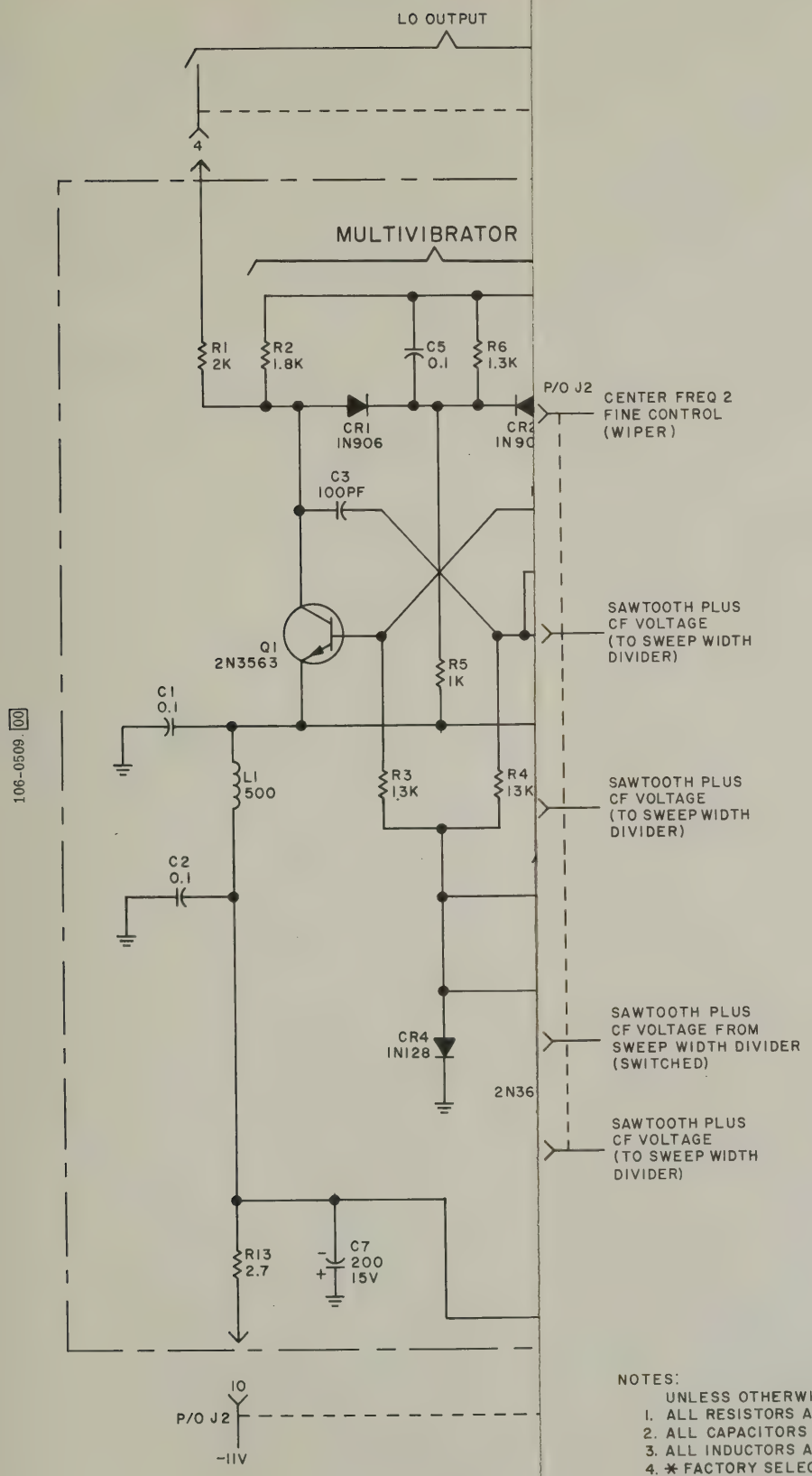
Figure 5-6. Narrow Band Oscillator and Sawtooth Generator Assembly A6, Schematic Diagram



NOTES:
UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, 1/4 W, ±5%.
2. ALL CAPACITORS ARE IN MICROFARADS.
3. ALL INDUCTORS ARE IN MICROHENRIES.
4. * FACTORY SELECTED COMPONENT. (NOMINAL VALUE SHOWN)
5. [ ] DENOTES INTERNAL MARKING.

Figure 5-7. Local Oscillator and Control Assembly A2, Schematic Diagram

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NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS, 1/4W, ±5%.
2. ALL CAPACITORS ARE IN MICROFARADS.

Figure 5-6. Narrow Band Oscillator and Sawtooth Generator Assembly A6, Schematic Diagram

106-0509 00

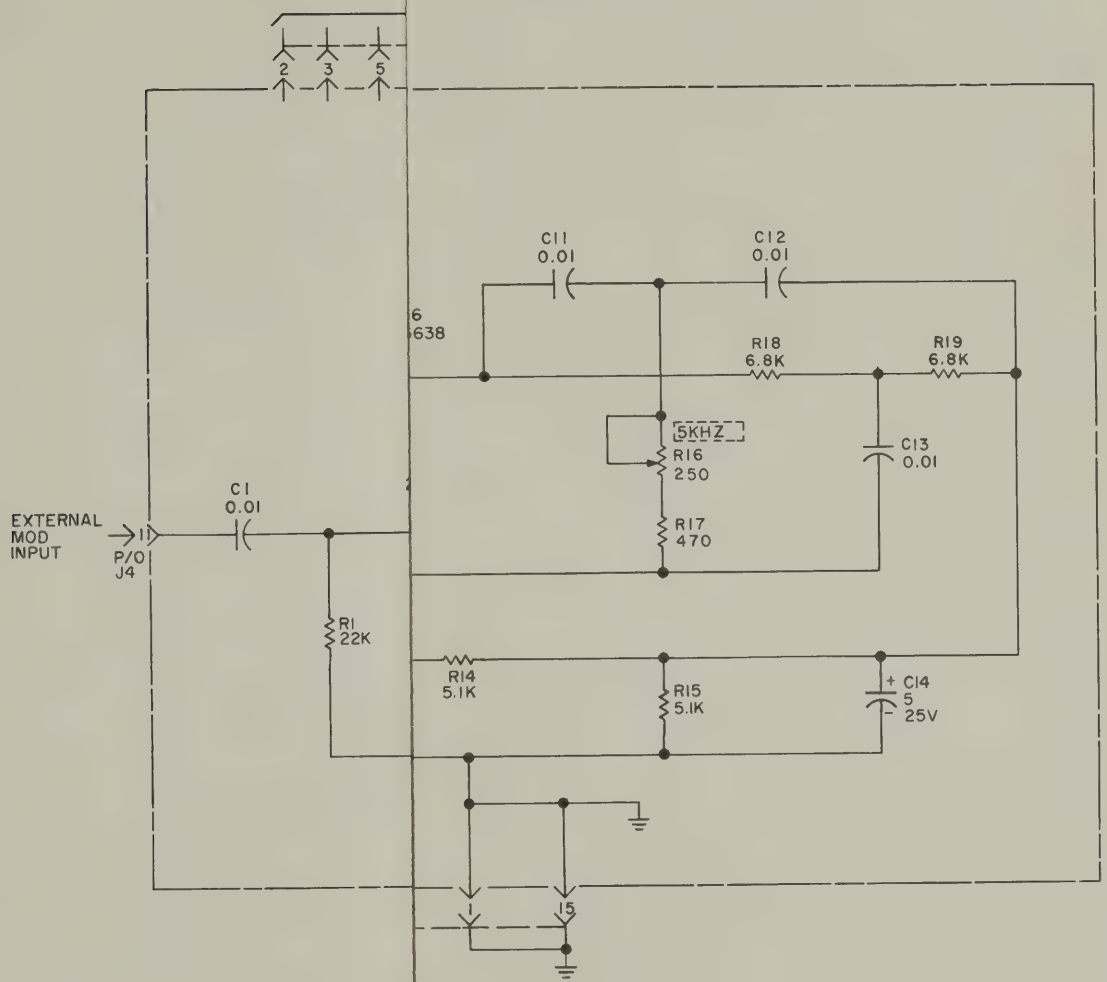
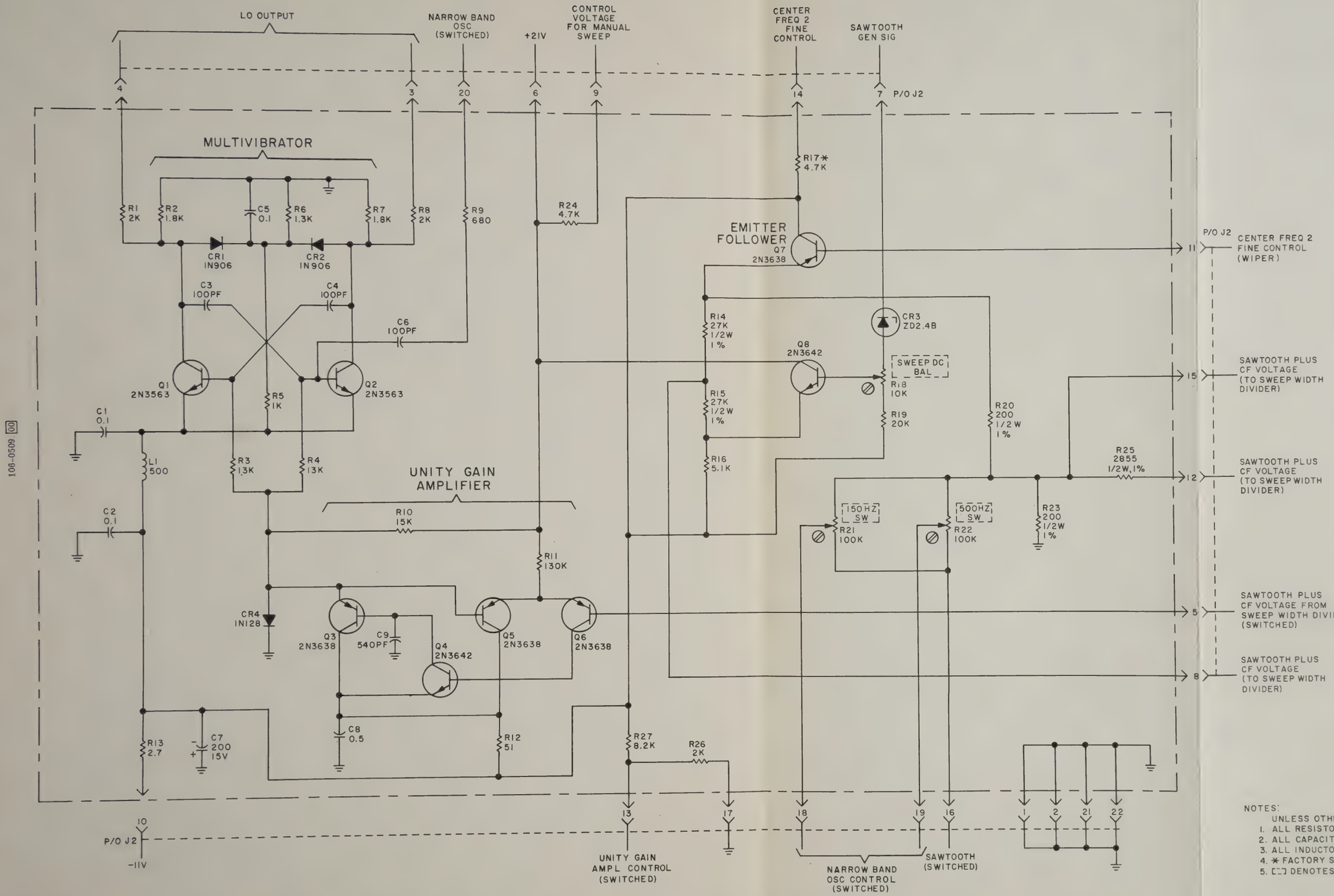


Figure 5-8. Calibration Oscillator and 5-kHz Marker Generator Assembly A4, Schematic Diagram



106-0509 00

NOTES:
UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, 1/4W, ±5%.
2. ALL CAPACITORS ARE IN MICROFARADS.
3. ALL INDUCTORS ARE IN MICROHENRIES.
4. * FACTORY SELECTED COMPONENT. (NOMINAL VALUE SHOWN)
5. [ ] DENOTES INTERNAL MARKING.

Figure 5-7. Local Oscillator and Control Assembly A2, Schematic Diagram

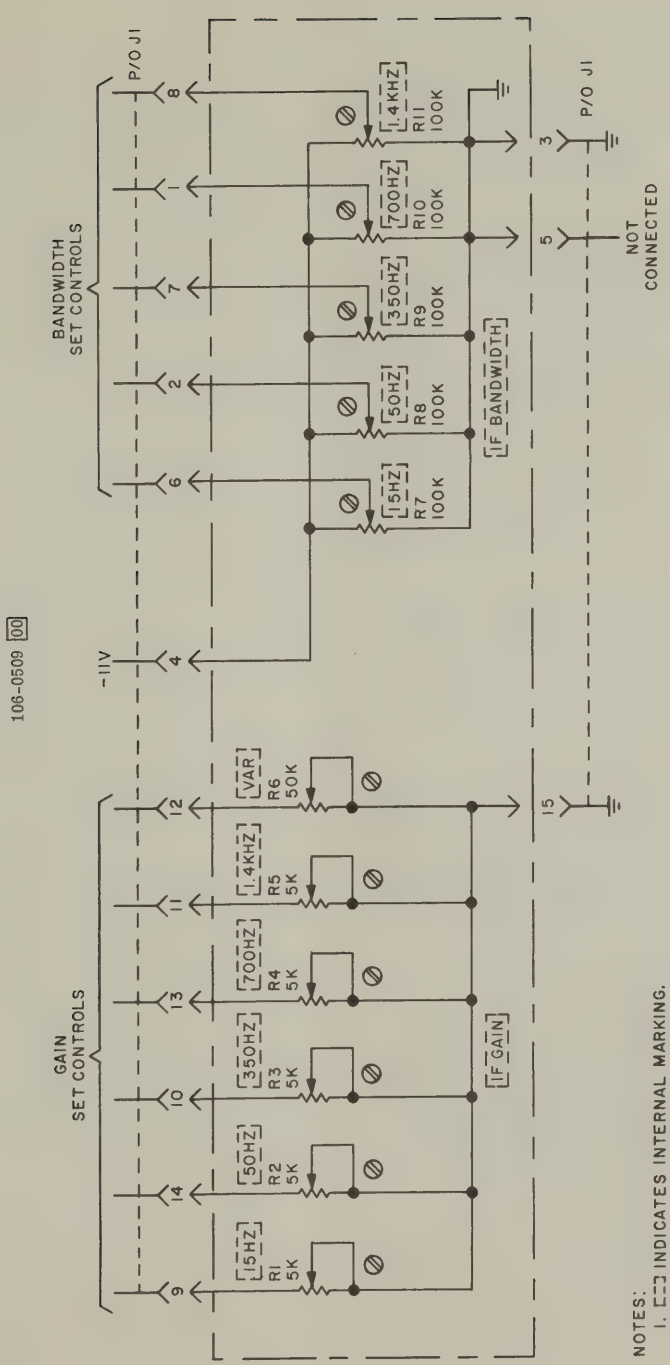


Figure 5-9. Gain and Bandwidth Control, Schematic Diagram

SECTION VI
PARTS LIST

6-1. INTRODUCTION.

6-2. This parts list section includes all pertinent data necessary to locate, identify, and procure additional parts for the equipment. Parts are listed alpha-numerically by reference symbol and include all replaceable items such as electronic, electro-mechanical, and mechanical parts of the equipment. In some cases, values, ratings and manufacturer sources shown are nominal and variations may be found. Satisfactory replacement may be made with either the listed component or an exact replacement of the part(s) removed from the equipment.

6-3. ORDERING INFORMATION.

6-4. The following instructions will aid in ordering parts from the Parts Lists, table 6-2.

a. Address all inquiries or orders to:

CUSTOMER SERVICE
Department 500-1
The Singer Company
Metrics Division
915 Pembroke Street
Bridgeport, Connecticut 06608

b. Include the following information:

1) Model and Serial Number of instrument.
2) Singer Part Number.
3) Reference Symbol Number.
4) Description (as shown on list).

6-5. HOW TO USE THE PARTS LIST.

6-6. Paragraphs 6-7 through 6-11 describe the use and meaning of the five columns included in the parts list (see figure 6-1).

6-7. REF SYMBOL COLUMN. The Ref Symbol Column (1, figure 6-1) contains an alpha-numerical listing of parts as they appear on equipment chassis, illustration, or schematic. The reference designation identifies the parts as to their component function in the instrument.

6-8. DESCRIPTION COLUMN. The Description Column (2, figure 6-1) contains the identification of component parts including all pertinent specifications and Singer part number. When the description column is used for a part which is identical to a part which has already been described; SAME AS (3) is used along with the reference symbol of the previously used part. In these instances, columns 3, 4, 5 are left blank. When the description column is used for a reference symbol for which no part exists; NOT USED (4) is placed in the column. In these instances, columns 3, 4, 5, are left blank.

6-9. MANUFACTURER'S PART NUMBER COLUMN. The Manufacturer's Part Number column (5, figure 6-1) contains the part number as designated by the manufacturer of the part.

6-10. MFR'S CODE COLUMN. The Mfr's Code column (6, figure 6-1) references the manufacturer by an assigned code number as listed in Federal Supply Code Handbook H4-2. For manufacturers not listed in H4-2, a letter code will be assigned. Table 6-1 includes the manufacturer and his code designation.

6-11. MAINT QTY COLUMN. The Maint Qty column (7, figure 6-1) contains the number of additional components recommended to keep the equipment at an optimum performance level. The recommended number of components in the Maint Qty column is based on 2000 hours of equipment operation.

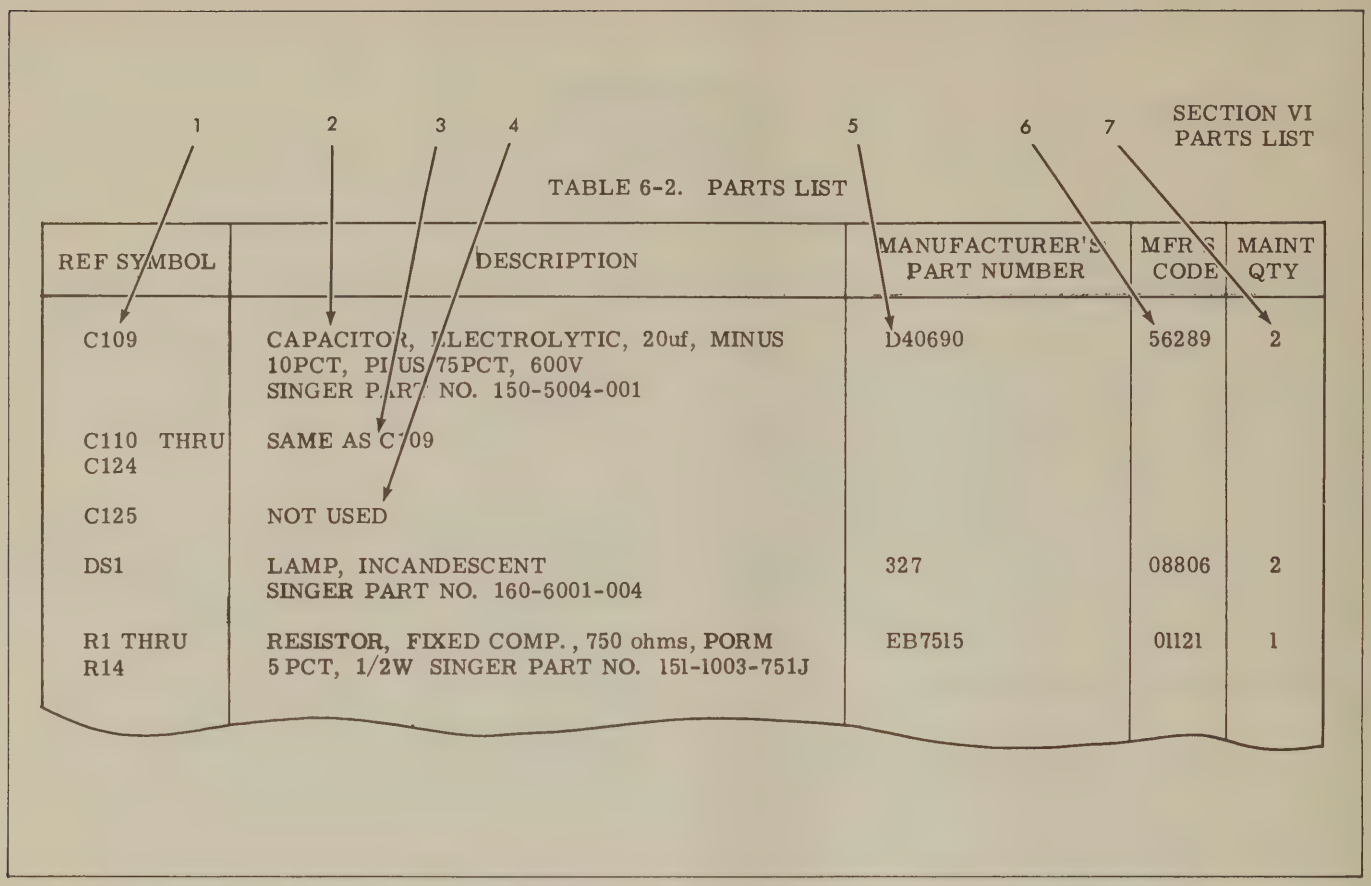


Figure 6-1. Parts List Sample

TABLE 6-1. MANUFACTURER'S CODE

Number	Name
00656	Aerovox Corp. New Bedford, Mass
01002	General Electric Co. Capacitor Department Hudson Falls, N.Y.
01121	Allen-Bradley Co Milwaukee, Wis.
01281	TRW Semiconductors Inc. Lawndale, Calif.
01295	Texas Instruments Inc. Semiconductor-Components Division Dallas, Texas
02660	Amphenol-Borg Electronics Corp. Maywood, Ill.
02777	Hopkins Engineering Co. San Fernando, Calif.
07263	Fairchild Camera and Instrument Corp. Semiconductor Division Mountain View, Calif.
12060	Diodes Inc., Chatsworth, Calif.
12126	Kidco Inc., Medford, N.J.
12697	Clarostat Mfg. Co., Inc. Dover, N.H.
13327	Solitron Devices Inc. Tappan, N.Y.
16665	The Singer Co., Metric Div. Bridgeport, Conn.
43543	Nytronics Inc. N.Y. Transformer Division Alpha, N.J.
56289	Sprague Electric Co. Nroth Adams, Mass.
71450	CTC Corp., Elkhart, Ind.
71482	C.P. Clare and Co. Chicago, Ill.
71590	Centralab Division of Globe-Union Inc. Milwaukee, Wis.

TABLE 6-1. MANUFACTURER'S CODE (Cont'd)

Number	Name
71753	Tietzmann Tool Corp. Englewood, Ohio
72136	Electro-Motive Mfg. Co., Inc. Willimantic, Conn.
72982	Erie Technological Products Inc. Erie, Pa.
73138	Beckman Instruments Inc. Helipot Division Fullerton, Calif.
76487	James Millen Mfg. Co. Inc. Malden, Mass.
76493	J.W. Miller Co. Los Angeles, Calif.
78488	Stackpole Carbon Co. St. Marys, Pa.
80294	Bourns, Inc. Riverside, Calif.
81349	Military Specifications
82142	Jeffers Electronics Division of Speer Carbon Co. DuBois, Pa.
82389	Swtichcraft Inc. Chicago, Ill.
89536	John Fluke Mfg. Co. Inc. Seattle, Wash.
91506	Augat Inc. Attleboro, Mass.
95146	Alco Electronics Mfg. Co. Lawrence, Mass.
95354	Methode Mfg. Co. Chicago, Ill.
99378	Atlee Corp., Winchester,Mass.

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
C1	CAPACITOR,ELECTROLYTIC, 30 UF,15V SINGER PART NO. 556074-025	30D306G015CBO	56289	1
C2	CAPACITOR,FIXED,METALLIZED, 2 UF,50V SINGER PART NO. 556146-719	2PP5D	02777	1
C3	CAPACITOR,FIXED,METALLIZED PAPER, 0.1 UF, PORM 20 PCT,200V SINGER PART NO. 556120-120	P12D	02777	1
C4	CAPACITOR,FIXED,CERAMIC DISC,0.002 UF,PORM 10 PCT,500V SINGER PART NO. 150-1002-202KKE	871-000R2P0202R	72982	1
C5	CAPACITOR,FIXED,DIPPED MICA, 120 PF,PORM 5 PCT,500V SINGER PART NO. 150-2002-121EJO	DM15E121J0500WV4CR	72136	1
C6	CAPACITOR,FIXED,ELECTROLYTIC, 10 UF,MINUS 10 PCT,PLUS 75 PCT,25V SINGER PART NO. 150-5001-100ES	40D179A2	56289	1
C7	CAPACITOR,FIXED,ELECTROLYTIC, 5 UF, 50V SINGER PART NO. 556074-169	CE11C050G	56289	1
C8	CAPACITOR,FIXED,DIPPED MICA, 47 PF,PORM 5 PCT,500V SINGER PART NO. 150-2002-470EJO	DM15E470J0500WV4CR	72136	1
C9 AND C10	CAPACITOR,FIXED,DIPPED MICA, 620 PF,PORM 5 PCT,500V SINGER PART NO. 150-2002-621EJO	DM15E621J0500WV4C9	72136	1
J1	CONNECTOR,PRINTED CIRCUIT, 15 CONTACTS SINGER PART NO. 168-3002-005	CD-615S	95354	1
J2	CONNECTOR,PRINTED CIRCUIT, 22 CONTACTS SINGER PART NO. 168-3002-007	CD-622S	95354	1
J3 THRU J8	SAME AS J1			
J9 AND J10	CONNECTOR,JACK, BNC TYPE SINGER PART NO. 168-4006-001	UG1094/U	81349	1
J11	CONNECTOR,JACK SINGER PART NO. 556146-560	57HA3F	82389	1
J12	SAME AS J9			
L1 AND L2	CHOKE,RF 1 MH SINGER PART NO. 556012-196	J300-1000	76487	1
L3 AND L4	CHOKE, 2.2 MH SINGER PART NO. 556146-721	73F223AF	76493	1
L5	CHOKE,RF, 220 UH SINGER PART NO. 556012-182	70F224A1	76493	1
P1	CONNECTOR,PLUG SINGER PART NO. 556166-045	26-159-16	02660	1
R1	RESISTOR,VARIABLE, 10K OHMS,PORM 10 PCT,2W	151-0007-066	16665	1
R2	RESISTOR,VARIABLE,DUAL CONCENTRIC, 100 OHMS / 3.5K OHMS,PORM 10 PCT,2W	556146-631	16665	1

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
R3	RESISTOR,FIXED,COMP., 6.2K OHMS,PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-622J	CB6225	01121	1
R4	NON-REPLACEABLE PART OF R2			
R5	RESISTOR,VARIABLE, 2.5K OHMS,PORM 10 PCT, 2W	151-0007-064	16665	1
R6	RESISTOR,FIXED,COMP., 510 OHMS,PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-511J	CB5115	01121	1
R7	RESISTOR,VARIABLE,DUAL CONCENTRIC, 100K/100K PORM 10 PCT,2W	556146-630	16665	1
R8	RESISTOR,FIXED,FILM, 2945 OHMS,PORM 1 PCT, 1/8W SINGER PART NO. 556146-647	TYPE RN60C	81349	1
R9	RESISTOR,FIXED,FILM, 5975 OHMS,PORM 1 PCT, 1/8W SINGER PART NO. 556146-646	TYPE RN60C	81349	1
R10	RESISTOR,VARIABLE, 2K OHMS,PORM PCT SINGER PART NO. 556146-890	20A/2K	89536	1
R11	RESISTOR,VARIABLE, 100K OHMS SINGER PART NO. 556146-722	GA2G204P104MA	01121	1
R12	SAME AS R6			
R13	NON-REPLACEABLE PART OF R7			
R14	RESISTOR,FIXED,COMP., 100K OHMS,PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-104J	CB1045	01121	2
R15	RESISTOR,VARIABLE, 3.5K OHMS SINGER PART NO. 556146-723	GA2G204P352MA	01121	1
S1	SWITCH,ROTARY,SWEEP WIDTH	133-0081-001	16665	1
S2	SWITCH,TOGGLE, SPDT SINGER PART NO. 556146-724	MST-105E	95146	1
S3	SWITCH,TOGGLE,DPDT SINGER PART NO. 133-0069-001	MST-205-N	95146	1
S4	SWITCH,TOGGLE, SPDT SINGER PART NO. 556146-725	MST-105D	95146	1
S5	SWITCH,LEVER,SWEEP MODE	133-0082-001	16665	1
S6	SWITCH,ROTARY,SWEEP RATE	133-0080-001	16665	1
S7	SWITCH,ROTARY,TEST SIGNAL	133-0079-001	16665	1
A1	GAIN AND BANDWIDTH CONTROL ASSY	103-1597-001	16665	1
A1R1 THRU A1R5	RESISTOR,VARIABLE, 5K OHMS,PORM 30 PCT,1/8W	151-0021-005	16665	1
A1R6	RESISTOR,VARIABLE, 50K OHMS SINGER PART NO. 556146-633	HT-U-201-503	71450	1
A1R7 THRU A1R11	RESISTOR,VARIABLE, 100K OHMS SINGER PART NO. 556146-632	HT-U-201-104	71450	1
A2	LOCAL OSC. AND CONTROL ASSY	103-1598-001	16665	1
A2CR1 AND A2CR2	SEMICONDUCTOR DEVICE,DIODE SINGER PART NO. 556118-168	IN906	81349	1

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A2CR3	SEMICONDUCTOR DEVICE,DIODE SINGER PART NO. 556146-729	ZD4.7B	12060	1
A2CR4	SEMICONDUCTOR DEVICE,DIODE SINGER PART NO. 556118-045	IN128	81349	1
A2C1 AND A2C2	CAPACITOR,FIXED,CERAMIC DISC, 0.1 UF,PORM 20 PCT,25V SINGER PART NO. 556120-162	5C7	56289	5
A2C3 AND A2C4	CAPACITOR,FIXED,DIPPED MICA, 100 PF,PORM 5 PCT,500V SINGER PART NO. 150-2002-101EJO	DM15E101J0500WV4CR	72136	1
A2C5	SAME AS A2C1			
A2C6	SAME AS A2C3			
A2C7	CAPACITOR,FIXED,ELECTROLYTIC, 200 UF,MINUS 10 PCT,PLUS 75 PCT,15V SINGER PART NO. 150-5001-201DS	TYPE 40D	56289	1
A2C8	CAPACITOR,FIXED,METALLIZED, 0.5 UF,50V SINGER PART NO. 556146-720	P5P5D	02777	1
A2C9	CAPACITOR,FIXED,DIPPED MICA, 540 PF,PORM 5 PCT,300V SINGER PART NO. 150-2002-541EJO	DM15E541J0300WV4CR	72136	1
A2L1	CHOKE,RF 500 UH SINGER PART NO. 556012-022	J300-500	76487	1
A2Q1 AND A2Q2	TRANSISTOR SINGER PART NO. 556146-251	2N3563	81349	1
A2Q3	TRANSISTOR SINGER PART NO. 556146-255	2N3638	81349	3
A2Q4	TRANSISTOR SINGER PART NO. 556146-702	2N3642	07263	3
A2Q5 THRU A2Q7	SAME AS A2Q3			
A2Q8	SAME AS A2Q4			
A2R1	RESISTOR,FIXED,COMP., 2K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-202J	CB2025	01121	6
A2R2	RESISTOR,FIXED,COMP., 1.8K OHMS,PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-182J	CB1825	01121	1
A2R3 AND A2R4	RESISTOR,FIXED,COMP., 13K OHMS,PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-133J	CB1335	01121	1
A2R5	RESISTOR,FIXED,COMP., 1K OHMS,PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-102J	CB1025	01121	6
A2R6	RESISTOR,FIXED,COMP., 1.2K OHMS,PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-122J	CB1225	01121	2
A2R7	SAME AS A2R2			
A2R8	SAME AS A2R1			
A2R9	RESISTOR,FIXED,COMP., 680 OHMS,PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-681J	CB6815	01121	1
A2R10	RESISTOR,FIXED,COMP., 15K OHMS,PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-153J	CB1535	01121	1
A2R11	RESISTOR,FIXED,COMP., 130K OHMS,PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-134J	CB1345	01121	1

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A2R12	RESISTOR,FIXED,COMP., 51 OHMS,PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-510J	CB5105	01121	1
A2R13	RESISTOR,FIXED,COMP., 2.7 OHMS,PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-2R7J	CB2R75	01121	1
A2R14 AND A2R15	RESISTOR,FIXED,PREC., 27K OHMS,PORM 1 PCT, 1/2W SINGER PART NO. 556029-461			
A2R16	RESISTOR,FIXED,COMP.,5.1K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-512J	CB5125	01121	2
A2R17	RESISTOR,FIXED,COMP., 4.3K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-432J	CB4325	01121	1
A2R18	RESISTOR,VARIABLE, 10 K OHMS SINGER PART NO. 556056-125	X201R103B	71450	1
A2R19	RESISTOR,FIXED,COMP., 20K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-203J	CB2035	01121	1
A2R20	RESISTOR,FIXED,PREC., 200 OHMS,PORM 1 PCT, 1/8W SINGER PART NO. 151-1008-B2000F	C1/8E2000HMSPORM1PCT	12126	1
A2R21 AND A2R22	RESISTOR,VARIABLE, 100K OHMS SINGER PART NO. 556056-128	X201R104B	71450	1
A2R23	SAME AS A2R20			
A2R24	RESISTOR,FIXED,COMP., 4.7K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-472J	CB4725	01121	1
A2R25	RESISTOR,FIXED,FILM, 2855 OHMS,PORM 1 PCT, 1/2W SINGER PART NO. 556146-732	TYPE RN65D	81349	1
A2R26	SAME AS A2R1			
A2R27	RESISTOR,FIXED,COMP., 8.2K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-822J	CB8225	01121	1
A3	TWO-TONE GENERATOR AND SECOND MIXER	103-1599-001	16665	1
A3CR1 THRU A3CR4	SEMICONDUCTOR DEVICE,DIODE SINGER PART NO. 556146-880	FDH666	07263	1
A3C1	SAME AS A2C8			
A3C2 AND A3C3	CAPACITOR, FIXED, CERAMIC, DISC, 0.01 UF, PLUS 80 MINUS 20 PCT, 100V SINGER PART NO. 556060-084	805-000X5V0103Z	72982	5
A3C4	CAPACITOR,FIXED,CERAMIC DISC,0.022 UF,PLUS 80 MINUS 20 PCT,25V SINGER PART NO. 556060-105	C069B250G223Z	56289	1
A3C5	SAME AS C3			
A3C6 AND A3C7	CAPACITOR,FIXED,DIPPED MICA, 200 PF,PORM 5 PCT,500V SINGER PART NO. 150-2002-201EJO	DM15E201J0500WV4CR	72136	1
A3Q1 AND A3Q2	SAME AS A2Q3			
A3Q3 AND A3Q4	TRANSISTOR SINGER PART NO. 556146-401	2N3638A	81349	1
A3R1	RESISTOR,FIXED,COMP., 39 OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-390J	CB3905	01121	1

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A3R2	SAME AS A2R9			
A3R3 AND A3R4	RESISTOR,FIXED,COMP., 100 OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-101J	CB1015	01121	1
A3R5 THRU A3R8	SAME AS A2R5			
A3R9	SAME AS A2R1			
A3R10	RESISTOR,FIXED,COMP., 3K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-302J	CB3025	01121	2
A3R11	RESISTOR,FIXED,COMP., 3.6K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-362J	CB3625	01121	3
A3R12	RESISTOR,FIXED,COMP., 2.2K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-222J	CB2225	01121	1
A3R13	RESISTOR,FIXED,COMP., 12K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-123J	CB1235	01121	2
A3R14	RESISTOR,FIXED,COMP., 330K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-334J	CB3345	01121	1
A3R15	RESISTOR,VARIABLE, 5K,OHMS,PORM 30 PCT,1/8W SINGER PART NO. 556146-541	X201R502B	71450	1
A3R16	SAME AS A3R13			
A3R17	SAME AS A3R14			
A3R18	SAME AS A3R11			
A3R19	SAME AS A3R12			
A3T1	TRANSFORMER,MIXER INPUT	132-0045-001	16665	1
A3T2	TRANSFORMER,MIXER OUTPUT	132-0044-001	16665	1
A3Y1	CRYSTAL, 3000 KHZ	556025-018	16665	1
A3Y2	CRYSTAL, 3002 KHZ	556025-019	16665	1
A3XY1 AND A3XY2	SOCKET,CRYSTAL SINGER PART NO. 556024-164	8000-AG-4	91506	1
A4	CAL. OSCILLATOR AND 5KHZ MARKER ASSY CIRCUIT BOARD	103-1600-001	16665	1
A4C1 AND A4C2	SAME AS A3C2			
A4C3	SAME AS C3			
A4C4	SAME AS A2C9			
A4C5	CAPACITOR,FIXED,DIPPED MICA, 470 PF,PORM 5 PCT,500V SINGER PART NO. 150-2002-471EJ0	DM15E471J0500WV4CR	72136	1
A4C6	CAPACITOR,FIXED,DIPPED MICA, 1000 PF,PORM 5 PCT,100V SINGER PART NO. 150-2002-102EJ0	DM15E102J0100WV4CR	72136	2
A4C7	SAME AS A3C2			

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A4C8	CAPACITOR,FIXED,ELECTROLYTIC, 10 UF,PLUS 100 MINUS 10 PCT,15V SINGER PART NO. 556146-642	CRE457A	00656	1
A4C9 AND A4C10	CAPACITOR,FIXED,ELECTROLYTIC, 5 UF,25V SINGER PART NO. 556166-119	TE1202	56289	1
A4C11 THRU A4C13	CAPACITOR,FIXED,DIPPED MICA, 10000 PF,PORM 5 PCT,500V SINGER PART NO. 150-2004-103FJO	DM30F103J0500WV4CR	72136	1
A4C14	SAME AS A4C9			
A4L1	CHOKE,RF 100 UH SINGER PART NO. 556012-191	1326-7	82142	1
A4Q1 AND A4Q2	SAME AS A2Q3			
A4Q3	SAME AS A3Q3			
A4Q4 THRU A4Q6	SAME AS A2Q3			
A4R1 AND A4R2	RESISTOR,FIXED,COMP., 22K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-223J	CB2235	01121	2
A4R3	RESISTOR,FIXED,COMP., 3.3K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-332J	CB3325	01121	1
A4R4	RESISTOR,FIXED,COMP., 68K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-683J	CB6835	01121	1
A4R5	SAME AS R14			
A4R6	SAME AS A2R5			
A4R7 AND A4R8	SAME AS A2R1			
A4R9	SAME AS R14			
A4R10	RESISTOR,FIXED,COMP., 560 OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-561J	CB5615	01121	1
A4R11	SAME AS R14			
A4R12	RESISTOR,FIXED,COMP., 47 OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-470J	CB4705	01121	1
A4R13	SAME AS A4R3			
A4R14 AND A4R15	RESISTOR,FIXED,COMP., 5.1K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-512J	CB5125	01121	1
A4R16	RESISTOR,VARIABLE 250 OHMS SINGER PART NO. 556146-649	X201R251B	71450	1
A4R17	RESISTOR,FIXED,COMP., 470 OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-471J	CB4715	01121	2
A4R18 AND A4R19	RESISTOR,FIXED,COMP., 6.8K OHMS,POR8 5 PCT 1/4W SINGER PART NO. 151-1002-682J	CB6825	01121	1
A4Y1	CRYSTAL, 500 KHZ	556025-020	16665	1
A4XY1	SAME AS A3XY1			

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A5	500KHZ AMPLIFIER ASSY	103-1601-001	16665	1
A5C1 THRU A5C4	SAME AS A3C2			
A5C5	SAME AS A2C1			
A5C6	CAPACITOR,FIXED,ELECTROLYTIC, 50 UF,25V SINGER PART NO. 556075-009	40D184A2	56289	1
A5C7	CAPACITOR,FIXED,DIPPED MICA, 62 PF,PORM 5 PCT,500V SINGER PART NO. 150-2002-620EJO	DM15E620J0500WV4CR	72136	1
A5C8	CAPACITOR,FIXED,COMP., 1.5 PF,PORM 5 PCT, 500V SINGER PART NO. 150-4001-1R5J	TYPE GA /1.5PF	78488	1
A5C9	SAME AS A5C7			
A5FL1	500KHZ BANDPASS FILTER	132-0047-001	16665	1
A5L1	CHOKE,RF,MOLDED,2000 UH SINGER PART NO. 156-7001-007	1312-26J	82142	1
A5L2	SAME AS A2L1			
A5Q1	SAME AS A2Q3			
A5Q2	TRANSISTOR SINGER PART NO. 556146-254	2N3565	81349	1
A5Q3 AND A5Q4	SAME AS A2Q4			
A5R1	SAME AS A2R16			
A5R2	RESISTOR,FIXED,COMP., 33K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-333J	CB3335	01121	2
A5R3	SAME AS A2R1			
A5R4	RESISTOR,FIXED,COMP., 43K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-433J	CB4335	01121	1
A5R5	SAME AS A2R27			
A5R6	SAME AS R3			
A5R7	RESISTOR,FIXED,COMP., 3.9K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-392J	CB3925	01121	1
A5R8	RESISTOR,FIXED,COMP., 120 OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-121J	CB1215	01121	1
A5R9	SAME AS A2R16			
A5R10	SAME AS A2R1			
A5R11	SAME AS A5R2			
A5R12	RESISTOR,FIXED,COMP., 1.2K OHMS,PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-122J	CB1225	01121	1
A5R13	SAME AS A3R10			
A5R14	SAME AS A2R18			
A5R15	SAME AS A2R1			

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A5R16	RESISTOR,FIXED,COMP., 1.2K OHMS,PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-122J	CB1225	01121	1
A5R17	RESISTOR,FIXED,COMP., 82K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-823J	CB8235	01121	1
A5R18	RESISTOR,VARIABLE, 50K SINGER PART NO. 556146-776	PAR-50K	73138	1
A5R19	SAME AS A2R21			
A5R20	SAME AS A2R5			
A6	OSCILLATOR AND SAWTOOTH GENERATOR ASSY	103-1602-001	16665	1
A6CR1	CAPACITOR,VARIABLE SINGER PART NO. 556146-730	VH900	13327	1
A6CR3	SAME AS A2CR3			
A6C1	CAPACITOR,FIXED,CERAMIC DISC, 0.001 UF,PORM 10 PCT,1000V SINGER PART NO. 556060-046	DD102	71590	1
A6C2	CAPACITOR,FIXED,DIPPED MICA, 33 PF,PORM 5 PCT,500V SINGER PART NO. 150-2002-330EJO	DM15E330J0500WV4CR	72136	1
A6C3	CAPACITOR,FIXED,METALLIZED PAPER, 0.22 UF, 50V SINGER PART NO. 556146-641	P22P5D	02777	1
A6C4	CAPACITOR,FIXED,DIPPED MICA, 24 PF,PORM 5 PCT,500V SINGER PART NO. 150-2002-240EJO	DM15E240J0500WV4CR	72136	1
A6C5	SAME AS A3C2			
A6C6	CAPACITOR,FIXED,DIPPED MICA, 5 PF,PORM .5 PF 500V SINGER PART NO. 150-2002-5ROCDO	DM15C5ROD0500WV4CR	72136	1
A6C7	CAPACITOR,FIXED,DIPPED MICA, 20 PF,PORM 5 PCT,500V SINGER PART NO. 150-2002-200CJO	DM15C200J0500WV4CR	72136	1
A6C8 AND A6C9	CAPACITOR,FIXED,DIPPED MICA, 3000PF,PORM 5 PCT,100V SINGER PART NO. 150-2002-302FJO	DM15F302J0100WV4CR	72136	1
A6C10	SAME AS A6C3			
A6C11	SAME AS A6C1			
A6C12 AND A6C13	SAME AS A2C8			
A6C14 THRU A6C17	SAME AS A3C2			
A6C18	CAPACITOR,FIXED,TANTALUM, 1.5 UF,20V SINGER PART NO. 556146-643	SCM155FP02A2	01295	1
A6C19	CAPACITOR,FIXED,TANTALUM, 22 UF,35V SINGER PART NO. 556146-644	SCM226GP0-35C2	01295	1
A6C20	SAME AS A6C7			
A6L1	COIL,VARIABLE, 1500UH SINGER PART NO. 556146-889	VIV-1500	43543	1
A6L2 AND A6L3	SAME AS A2L1			

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A6Q1	TRANSISTOR SINGER PART NO. 556146-726	2N3564	81349	1
A6Q2 AND A6Q3	SAME AS A2Q3			
A6Q4	SAME AS A2Q4			
A6Q5	SAME AS A2Q3			
A6Q6	TRANSISTOR SINGER PART NO. 556146-261	2N1671B	81349	1
A6R1	RESISTOR,FIXED,COMP., 1MEGOHM PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-105J	CB1055	01121	1
A6R2	SAME AS A2R5			
A6R3	RESISTOR,VARIABLE, 2K OHMS SINGER PART NO. 556146-734	62PAR2K	73138	1
A6R4	RESISTOR,FIXED,COMP., 10 OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-100J	CB1005	01121	1
A6R5	SAME AS A4R17			
A6R6	SAME AS A5R4			
A6R7	SAME AS A2R10			
A6R8	SAME AS A3R3			
A6R9	RESISTOR,FIXED,COMP., 430 OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-431J	CB4315	01121	1
A6R10	RESISTOR,FIXED,COMP., 10K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-103J	CB1035	01121	6
A6R11	SAME AS A2R1			
A6R12	SAME AS A2R16			
A6R13	SAME AS A2R5			
A6R14 AND A6R15	SAME AS A2R19			
A6R16	SAME AS A3R10			
A6R17	SAME AS R6			
A6R18	SAME AS A3R12			
A6R19	RESISTOR,FIXED,COMP., 56 OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-560J	CB5605	01121	1
A6R20	SAME AS A4R16			
A6R21	SAME AS A2R17			
A6R22	RESISTOR,FIXED,COMP., 51K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-513J	CB5135	01121	2
A6R23	SAME AS A2R16			
A6R24	RESISTOR,VARIABLE, 50K OHMS SINGER PART NO. 556056-129	X201R503B	71450	1

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A6R25	RESISTOR,FIXED,COMP., 75K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-753J	CB7535	01121	1
A6R26	SAME AS A2R18			
A6R27	SAME AS A2R2			
A7	LOG/LIN I-F AMPLIFIER ASSY	103-1603-001	16665	1
A7CR1 THRU A7CR14	SEMICONDUCTOR DEVICE,DIODE SINGER PART NO. 556118-046	IN251	81349	1
A7C1	SAME AS A6C1			
A7C2	CAPACITOR,FIXED,DIPPED MICA, 510PF,PORM 5 PCT,500V SINGER PART NO. 150-2002-511EJO	DM15E511J0500WV4CR	72136	1
A7C3	CAPACITOR,FIXED,DIPPED MICA, 150 PF,PORM 5 PCT,500V SINGER PART NO. 150-2002-151EJO	DM15E151J0500WV4CR	72136	1
A7C4	SAME AS A2C1			
A7C5	SAME AS A4C6			
A7C6	SAME AS A2C1			
A7C7	SAME AS A7C7			
A7C8	SAME AS A2C1			
A7C9	SAME AS A3C2			
A7C10	CAPACITOR,FIXED,ELECTROLYTIC, 50 UF,50V SINGER PART NO. 556073-004	TE1307	56289	1
A7C11	SAME AS A2C1			
A7C12	SAME AS A3C2			
A7C13	SAME AS A2C1			
A7C14	SAME AS A3C2			
A7C15	SAME AS A4C6			
A7C16	SAME AS A2C1			
A7C17	SAME AS A3C2			
A7C18	SAME AS A2C1			
A7C19	SAME AS A3C2			
A7C20	SAME AS A7C10			
A7C21	SAME AS A3C2			
A7C22 AND A7C23	SAME AS A2C1			
A7C24	SAME AS A3C2			
A7C25	SAME AS A2C1			
A7C26 THRU A7C31	SAME AS A3C2			

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A7C32 THRU A7C37	SAME AS A6C1			
A7C38	SAME AS A3C2			
A7C39	SAME AS A6C1			
A7C40	SAME AS A4C6			
A7C41	SAME AS A7C10			
A7C42	SAME AS A4C6			
A7C43 AND A7C44	SAME AS A2C1			
A7C45	SAME AS A3C2			
A7L1	CHOKE,VARIABLE	132-0214-001	16665	1
A7L2	CHOKE,RF SINGER PART NO. 556012-173	70F223A1	76493	1
A7L3	SAME AS L1			
A7L4	SAME AS A7L2			
A7L5 AND A7L6	SAME AS L1			
A7Q1	SAME AS A6Q1			
A7Q2	SAME AS A2Q4			
A7Q3 THRU A7Q5	SAME AS A6Q1			
A7Q6	SAME AS A2Q4			
A7Q7 THRU A7Q9	SAME AS A6Q1			
A7Q10 AND A7Q11	SAME AS A5Q2			
A7Q12	SAME AS A3Q3			
A7Q13	SAME AS A2Q4			
A7R1	SAME AS A6R22			
A7R2	SAME AS R3			
A7R3	SAME AS A4R17			
A7R4	RESISTOR,FIXED,COMP.,, 200 OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-201J	CB2015	01121	6
A7R5	SAME AS A6R22			
A7R6	SAME AS R3			
A7R7	SAME AS A4R17			
A7R8	SAME AS A3R10			
A7R9	SAME AS A7R4			

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A7R10	RESISTOR,FIXED,COMP., 18K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-183J	CB1835	01121	1
A7R11	SAME AS A3R11			
A7R12	RESISTOR,FIXED,COMP., 1.5K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-152J	CB1525	01121	2
A7R13 AND A7R14	SAME AS A7R4			
A7R15	SAME AS A2R5			
A7R16	SAME AS A7R10			
A7R17	SAME AS A3R11			
A7R18	SAME AS A7R12			
A7R19 AND A7R20	SAME AS A7R13			
A7R21	SAME AS A2R5			
A7R22	SAME AS A7R10			
A7R23	SAME AS A3R11			
A7R24	SAME AS A7R12			
A7R25 THRU A7R27	SAME AS A7R4			
A7R28	RESISTOR,FIXED,COMP., 27K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-273J	CB2735	01121	1
A7R29	SAME AS A2R5			
A7R30	RESISTOR,FIXED,COMP., 2.4K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-242J	CB2425	01121	1
A7R31	SAME AS A3R3			
A7R32	SAME AS A7R4			
A7R33	SAME AS A2R5			
A7R34	SAME AS A7R10			
A7R35	SAME AS A3R11			
A7R36	SAME AS A7R12			
A7R37 AND A7R38	SAME AS A7R4			
A7R39	SAME AS A2R5			
A7R40	SAME AS A7R10			
A7R41	SAME AS A3R11			
A7R42	SAME AS A7R12			
A7R43 AND A7R44	SAME AS A7R4			

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A7R45	SAME AS A2R5			
A7R46	SAME AS A7R10			
A7R47	SAME AS A3R11			
A7R48	RESISTOR,FIXED,COMP., 750 OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-751J	CB7515	01121	1
A7R49	RESISTOR,VARIABLE, 200 OHMS SINGER PART NO. 556146-735	62PR200	73138	1
A7R50	SAME AS A7R4			
A7R51	SAME AS A2R17			
A7R52 THRU A7R57	SAME AS A6R10			
A7R58	SAME AS A3R3			
A7R59	RESISTOR,VARIABLE, 1K OHMS SINGER PART NO. 556146-516	62PR-1K	73138	1
A7R60	RESISTOR,FIXED,COMP., 270 OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-271J	CB2715	01121	1
A7R61	RESISTOR,VARIABLE, 5 K OHMS SINGER PART NO. 556146-731	62PR5K	73138	1
A7R62	SAME AS A2R6			
A7R63	RESISTOR,FIXED,COMP., 39K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-393J	CB3935	01121	1
A7R64	SAME AS A5R8			
A7R65	SAME AS A7R63			
A7R66	RESISTOR,FIXED,COMP., 47K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-473J	CB4735	01121	1
A7R67	SAME AS A4R17			
A7R68	SAME AS A4R18			
A7R69	SAME AS A2R5			
A7R70	SAME AS A6R10			
A8	100KHZ CRYSTAL I-F AMPLIFIER ASSY	103-1604-001	16665	1
A8CR1 THRU A8CR6	SAME AS A7CR1			
A8C1 AND A8C2	SAME AS A2C1			
A8C3	CAPACITOR,FIXED,CERAMIC DISC, 0.47 UF,PORM 20 PCT,25V SINGER PART NO. 556120-160	5C11	56289	1
A8C4	CAPACITOR,VARIABLE, 5.5 TO 18 PF,350V SINGER PART NO. 150-4001-002	538-006-NPO,5.5-18PF	72982	1
A8C5	CAPACITOR,FIXED,DIPPED MICA, 10 PF,PORM 5 PCT,500V SINGER PART NO. 150-2002-100CJO	DM15C100J0500WV4CR	72136	1

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A8C6	SAME AS A2C3 FACTORY SELECTED			
A8C7	SAME AS A3C2			
A8C8	SAME AS A8C3			
A8C9	SAME AS A3C2			
A8C10 AND A8C11	SAME AS A8C3			
A8C12	SAME AS A3C2			
A8C13	CAPACITOR,FIXED,METALLIZED PAPER, 1 UF,PORM 5 PCT,50V SINGER PART NO. 556118-143	1PP5D	02777	1
A8C14	SAME AS A8CM			
A8C15	SAME AS A6C6			
A8C16	SAME AS A2C3 FACTORY SELECTED			
A8C17	SAME AS A3C2			
A8C18	SAME AS A8C3			
A8C19	SAME AS A3C2			
A8C20	SAME AS A8C13			
A8C21	SAME AS A8C4			
A8C22	SAME AS A6C6			
A8C23	SAME AS A2C3 FACTORY SELECTED			
A8C24	SAME AS A3C2			
A8C25	SAME AS A8C13			
A8C26 AND A8C27	SAME AS A3C2			
A8Q1 THRU A8Q15	SAME AS A2Q3			
A8R1 THRU A8R4	SAME AS A4R1			
A8R5	SAME AS A2R1			
A8R6 AND A8R7	SAME AS A3R10			
A8R8	SAME AS A2R1			
A8R9	SAME AS A3R13			
A8R10	SAME AS A5R2			
A8R11	SAME AS A6R22			
A8R12	RESISTOR,FIXED,COMP., 220 OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-221J	CB2215	01121	1
A8R13	SAME AS A2R5			

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A8R14	RESISTOR,FIXED,COMP., 7.5K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-752J	CB7525	01121	1
A8R15	NOT USED			
A8R16	SAME AS A6R10			
A8R16	SAME AS A2R5			
A8R17	RESISTOR,FIXED,COMP., 62K OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-623J	CB6235	01121	1
A8R18	SAME AS A2R16			
A8R19	SAME AS A6R10			
A8R20	RESISTOR,FIXED,COMP., 330 OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-331J	CB3315	01121	1
A8R21	SAME AS A2R1			
A8R22	SAME AS A6R10			
A8R23	SAME AS A6R8			
A8R24	SAME AS A6R10			
A8R25	RESISTOR,FIXED,COMP., 300 OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-301J	CB3015	01121	1
A8R26	SAME AS A3R13			
A8R27	SAME AS A5R2			
A8R28	SAME AS A6R22			
A8R29	SAME AS A2R1			
A8R30	SAME AS A8R12			
A8R31	SAME AS A2R5			
A8R32	SAME AS A8R14			
A8R33	SAME AS A6R10			
A8R34	SAME AS A2R5			
A8R35	SAME AS A8R25			
A8R36	SAME AS A3R13			
A8R37	SAME AS A5R2			
A8R38	SAME AS A6R22			
A8R39	SAME AS A8R12			
A8R40	SAME AS A3R3			
A8R41	RESISTOR,FIXED,COMP., 910 OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-911J	CB9115	01121	1
A8R42	SAME AS A8R14			
A8R43	SAME AS A6R10			

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A8R44	SAME AS A2R5			
A8R45	SAME AS A8R20			
A8R46 THRU A8R48	RESISTOR,FIXED,COMP., 390K OHMS,PORM 5 PCT 1/4W FACTORY SELECTED SINGER PATT NO. 151-1003-394J	CB3945	01121	1
A8T1	TRANSFORMER,RESOLUTION	132-0046-001	16665	1
A8T2	TRANSFORMER,INTER STAGE COUPLING	556162-174	16665	1
A8T3	SAME AS A8T1			
A8T4	SAME AS A8T2			
A8T5	SAME AS A8T3			
A8Y1 THRU A8Y3	CRYSTAL,100KC MATCHED TRIPLET SET CRYSTAL	556162-043	16665	1
A8XY1 THRU A8XY3	SOCKET,CRYSTAL	117-0381-001	16665	1
A9	MIXER ASSY	103-1596-001	16665	1
A9C1	CAPACITOR,FIXED,CERAMIC, 0.047 UF,PORM 20 PCT, SINGER PART NO. 556146-728	65F12AB473	01002	1
A9C2 AND A9C3	SAME AS A3C2			
A9C4	SAME AS A3C4			
A9Q1	TRANSISTOR SINGER PART NO. 556118-201	2N2996	81349	1
A9R1	SAME AS A2R5			
A9R2	RESISTOR,FIXED,COMP., 220 OHMS,PORM 5 PCT 1/4W SINGER PART NO. 151-1002-220J	CB2205	01121	1
A9R3	SAME AS A2R12			
A9R4	SAME AS A2R12			
A9R5	SAME AS A8R25			
A9R6	SAME AS A2R5			
A9R7	SAME AS A5R2			
A9R8	SAME AS A2R5			
A10	INPUT ATTENUATOR ASSY	103-1508-001	16665	1
A10C1	CAPACITOR,FIXED,CERAMIC DISC, 0.05UF,PLUS 80 PCT MINUS 20 PCT,200V SINGER PART NO. 556074-057	33C137	56289	1
A10C2	SAME AS A4C6			
A10C3	CAPACITOR,FIXED,DIPPED MICA, 240 PF,PORM 5 PCT,500V SINGER PART NO. 150-2002-241EJO	DM15E241J0500WV4CR	72136	1
A10R1	SAME AS A3R10			

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A10R2	SAME AS A2R5			
A10R3	RESISTOR,FIXED,PREC., 62.3 OHMS,PORM 1 PCT, 1/8W SINGER PART NO. 151-1008-B62R30F	C1/8E62.3OHMPORM1PCT	12126	1
A10R4	RESISTOR,FIXED,PREC., 253 OHMS,PORM 1 PCT, 1/8W SINGER PART NO. 151-1008-B2530F	C1/8E253OHMSPORM1PCT	12126	1
A10R5 AND A10R6	SAME AS A10R3			
A10R7	SAME AS A10R4			
A10R8	SAME AS A10R3			
A10R9	RESISTOR,FIXED,PREC., 72.8 OHMS,PORM 1 PCT, 1/8W SINGER PART NO. 151-1008-B72R80F	C1/8E72.8OHMPORM1PCT	12126	1
A10R10	RESISTOR,FIXED,PREC., 139 OHMS,PORM 1 PCT, 1/8W SINGER PART NO. 151-1008-B1390F	C1/8E139OHMSPORM1PCT	12126	1
A10R11	SAME AS A10R9			
A10R12	RESISTOR,FIXED,PREC., 116.5 OHMS,PORM 1 PCT, 1/8W SINGER PART NO. 556146-891	C1/8E116.5 OHMS 1PCT	12126	1
A10R13	RESISTOR,FIXED,PREC., 53.8 OHMS,PORM 1 PCT, 1/8W SINGER PART NO. 151-1008-B53R80F	C1/8E53.8OHMPORM1PCT	12126	1
A10R14	SAME AS A10R12			
A10R15	RESISTOR,FIXED,PREC., 226 OHMS,PORM 1 PCT, 1/8W SINGER PART NO. 151-1008-B2260F	C1/8E226OHMSPORM1PCT	12126	1
A10R16	RESISTOR,FIXED,PREC., 24.3 OHMS,PORM 1 PCT, 1/8W SINGER PART NO. 151-1008-B24R30F	C1/8E24.3OHMPORM1PCT	12126	1
A10R17	SAME AS A10R15			
A10R18	RESISTOR,FIXED,PREC., 445 OHMS,PORM 1 PCT, 1/8W SINGER PART NO. 151-1008-B4450F	C1/8E445OHMSPORM1PCT	12126	1
A10R19	RESISTOR,FIXED,PREC., 11.9 OHMS,PORM 1 PCT, 1/8W SINGER PART NO. 151-1008-B11R90F	C1/8E11.9OHMPORM1PCT	12126	1
A10R20	SAME AS A10R18			
A10R21	RESISTOR,FIXED,PREC., 887 OHMS,PORM 1 PCT, 1/8W SINGER PART NO. 151-1008-B8870F	C1/8E887OHMSPORM1PCT	12126	1
A10R22	RESISTOR,FIXED,PREC., 5.95 OHMS,PORM 1 PCT, 1/8W SINGER PART NO. 151-1008-B5R950F	C1/8E5.95OHMPORM1PCT	12126	1
A10R23	SAME AS A10R21			